DOCUMENT RESUME

ED 381 381 SE 056 172

AUTHOR Sharp, Laure; And Others
TITLE Short-Term Impact Study of the National Science Foundation's Young Scholars Program.
INSTITUTION Westat, Inc., Rockville, MD.
SPONS AGENCY National Science Foundation, Arlington, VA. Directorate for Education and Human Resources.
REPORT NO NSF-95-50
PUB DATE Dec 94
CONTRACT SED-92-55369
NOTE 61p.
PUB TYPE Reports - Evaluative/Feasibility (142)

EDRS PRICE MF01/PC03 Plus Postage.
DESCRIPTORS Black Students; *Career Choice; College Students; Higher Education; High Schools; High School Students; Junior High Schools; Junior High School Students; Program Effectiveness; *Program Evaluation; *Science Careers; Science Education; Science Programs; Sex Differences
IDENTIFIERS *National Science Foundation; *Young Scholars Program

ABSTRACT

This report summarizes the findings of an exploratory study of the short-term impact of the National Science Foundation's Young Scholars Program (YSP). The program awards grants on a competitive basis to projects located at higher education or advanced research facilities that can provide students with an intellectually stimulating research experience. A series of informal conversations were conducted in 1994 with small numbers of 1991 participants, applicants who did not participate, and a few parents of the 1991 participants. The purpose of the conversations was to explore in depth some of the short-term impacts of the YSP experience and to probe further the impacts suggested by an examination of a database of funded projects and participants, with respect to commitment to careers in science, mathematics, engineering, and technology. Taken together, findings suggest that there is little evidence that participation in the YSP, in and of itself, is a strong determiner of future pursuit of science, engineering, and mathematics careers. Rather, the program may be better seen as a mosaic of experiences that encourage bright, motivated students to pursue advanced degrees and select challenging professional roles. The report presents an introduction to the background; methodology; data analysis; and the results of conversations with participants, nonparticipants, and parents. A technical appendix contains sampling and data collection design, procedure, and outcomes. (LZ)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

Division of Research, Evaluation and Dissemination

SE

ED 381 381

Short-Term Impact Study of the National Science Foundation's Young Scholars Program

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

Sponsored by
the National Science Foundation

Prepared by Westat, Inc.

BEST COPY AVAILABLE

A RED-sponsored Report on Evaluation

National Science Foundation
Directorate for Education
and Human Resources

About the National Science Foundation

The Foundation provides awards for research in the sciences and engineering. The awardee is wholly responsible for the conduct of such research and preparation of the results for publication. The Foundation, therefore, does not assume responsibility for the research findings or their interpretation.

The Foundation welcomes proposals from all qualified scientists and engineers, and strongly encourages women, minorities, and persons with disabilities to compete fully in any of the research and related programs described here.

In accordance with federal statutes, regulations, and NSF policies, no person on grounds of race, color, age, sex, national origin, or disability shall be excluded from participation in, denied the benefits of, or be subject to discrimination under any program or activity receiving financial assistance from the National Science Foundation.

Facilitation Awards for Scientists and Engineers with Disabilities (FASED) provide funding for special assistance or equipment to enable persons with disabilities (investigators and other staff, including student research assistants) to work on an NSF project. See the program announcement or contact the program coordinator at (703) 306-1636.

The National Science Foundation has TTD (Telephone Device for the Deaf) capability, which enables individuals with hearing impairment to communicate with the Foundation about NSF programs, employment, or general information. This number is (703) 306-0090.

SHORT-TERM IMPACT STUDY OF THE NATIONAL SCIENCE FOUNDATION'S YOUNG SCHOLARS PROGRAM

Prepared under Contract
#SED 92-55369

by

Laure Sharp
Nancy Carey
Joy A. Frechtling
Ken Burgdorf
Westat, Inc.

December 1994

NSF Program Officer
Conrad Katzenmeyer

Directorate for Education
and Human Resources

Division of Research,
Evaluation, and Dissemination

PREFACE

This report summarizes the findings of an exploratory study of the short-term impact of the National Science Foundation's Young Scholars Program (YSP). The program awards grants on a competitive basis to projects located at higher education or advanced research facilities that can provide students with an intellectually stimulating research experience.

A data base containing information about funded projects, students who applied to the program, and students who participated in the program has been maintained since 1988 under a contract between NSF and the COSMOS Corporation. Participating students are also followed up 1 year after their participation, and beginning in 1993, their scholastic careers are being tracked annually through their sophomore year in college.

In 1994, NSF awarded a task order to Westat, Inc., to conduct a series of informal conversations with small numbers of 1991 participants and applicants who did not participate; conversations were also conducted with a few parents of the 1991 participants. The purpose of these conversations was to explore in depth some of the short-term impacts of the YSP experience and to probe further the impacts suggested by an examination of the data base with respect to commitment to careers in science, mathematics, engineering, and technology.

This report is based upon work supported by the National Science Foundation under NSF contract number SED 92-55369. Any opinions, conclusions, or recommendations expressed in this report are those of the authors and do not necessarily reflect the views of the National Science Foundation.

CONTENT

	Page
PREFACE	i
EXECUTIVE SUMMARY	v
CHAPTER 1. INTRODUCTION	1
Background	1
Methodology	1
Data Analysis	3
CHAPTER 2. CONVERSATIONS WITH PARTICIPANTS	5
General Impact of Participation	5
The Application Process	8
Current Status and Current Plans for Further Education and for Careers	10
The Impact of YSP	17
Putting It All Together	18
CHAPTER 3. CONVERSATIONS WITH NONPARTICIPANTS	25
Introduction	25
Characteristics of Nonparticipants	25
Reasons for Nonparticipation in the YSP Program	25
Participation in Similar Types of Programs	26
Current Status of Nonparticipants	26
Further Education	26
Career Plans	28
CHAPTER 4. CONVERSATIONS WITH PARENTS	31
Introduction	31
Topics Covered in Conversations	32
Findings	32
Conclusion	36
CHAPTER 5. CONCLUSIONS	39
TECHNICAL APPENDIX - SAMPLING AND DATA COLLECTION DESIGN, PROCEDURE, AND OUTCOMES	41

LIST OF TABLES

E-1	Demographic characteristics of participants and nonparticipants in weighted Westat samples	vi
1-1	Demographic characteristics of participants and nonparticipants in weighted Westat samples	3
2-1	Comparison of YSP experience with coursework	6

2-2	Did participants establish any significant (mentoring) relationships with adults through the Young Scholars Program?	7
2-3	Did participants establish any networks with other participants?	8
2-4	How participants learned about the Young Scholars Program (first source mentioned)	9
2-5	Who encouraged participant to apply?	9
2-6	1994 status of 1991 participants	10
2-7	Plans for future education	11
2-8	Participants' plans for field of graduate study	12
2-9	Choice of college major (actual or anticipated) of participants, by gender	13
2-10	College major (anticipated and actual) of participants, by gender and ethnicity (grouped data)	14
2-11	College major of YSP participants now in college and all U.S. students in 4-year colleges in 1989	14
2-12	Career plans for participants, by gender and ethnicity	15
2-13	Career plans (by major or anticipated major) of participants, by gender	16
2-14	Career plans (by major or anticipated major) of participants, by ethnicity	16
2-15	Percentage of participants reporting *very strong* interest in science at 3 points in time	17
2-16	Impact of YSP on career plans	19
2-17	Perception of SEM professions	20
3-1	Percentage of nonparticipants indicating their reasons for not attending the YSP, by gender	26
3-2	Percentage of students indicating that they had participated in a similar type of program, by gender	26
3-3	Percentage of nonparticipants indicating their post-college plans, by gender	27
3-4	Percentage of nonparticipants indicating their anticipated and actual college majors, by gender	28
3-5	Percentage of nonparticipants indicating their career plans, by gender	29
4-1	Characteristics of all YSP participants in Westat study and of those whose parents were interviewed	31

LIST OF FIGURES

E-1	Choice of college majors	viii
E-2	Career plans	ix

EXECUTIVE SUMMARY

Background

The Young Scholars Program (YSP) was designed to inform and excite students about science, engineering, mathematics, and technology and to encourage them to investigate and pursue careers in these fields. The program targets bright, promising students, most of whom have a record of high achievement and an interest in science and science-related fields. Experiences offered to students are very diverse, including programs on university and college campuses, on research vessels and at archeological digs, at museums and zoological gardens, and in industry. The experiences vary in duration from 3 to 8 weeks and are generally held over the summer.

Through participation in YSP projects, students are expected to

- gain greater knowledge of and exposure to science, engineering, mathematics, and/or technology, obtaining the information needed for making realistic decisions based on the full range of career options;
- develop interests in research and in science and mathematics education as possible career choices;
- become aware of the academic preparation necessary for such careers;
- become acquainted with the environment and resources of universities, colleges, and research organizations; and
- gain increased confidence in their ability to make career decisions.

The short-term impact study reported here focused primarily on the second of these goals, but information with respect to the other four goals was also supplied by study participants and is reported here. Since 1988, a longitudinal data base has been maintained to track former participants; this data base also focuses on career choices, and one of the aims of the present study was to elucidate some of the information that the data base has yielded. In this report, we present both soft indicators, that is, the students' self-assessment of the extent to which the program affected their interest in science, engineering, and mathematics (SEM), and harder indicators about the students' study and career plans as reflected in the choice of college majors and the actual careers they were considering.

Methodology

To find out more about the impact of the Young Scholars Program, we held conversations in the summer of 1994 with some former participants in programs during the summer of 1991 (N=199), their parents (N=52), and students who had applied, but for various reasons did not attend YSP-sponsored programs (N=70). The goal was to develop a picture of the program as a whole, rather than to study particular projects. Given the fundamental differences in academic preparation and stage of decision making concerning future career choice between the 1991 junior and senior high school participants (with the older students in college and most having chosen a major when this study was conducted), it was necessary to examine the data separately for these two groups of participants and nonparticipants. The small size of the samples made further subgroup comparisons difficult. We were able to look separately at the data for males and females, since the projects included the same proportion of participants of both sexes. With respect to ethnicity, the high proportion of nonwhite students who participated in the program should be noted. However, the numbers for the various ethnic groups were too small to permit separate analysis, except for African Americans (see Technical Appendix, Table 5). Table E-1 shows the characteristics of the participants and nonparticipants weighted up to the original population.

Findings

The study indicates that the Young Scholars Program offers an educational experience that is seen by almost all participants to be stimulating, exciting, and challenging. However, its impact on the SEM pipeline is far less clear.

The findings present a dilemma for those seeking a simple answer to whether or not the program was successful. Despite participants' enthusiastic comments about the quality of the learning experience, we found few differences in college majors and career choices between the participants and those who applied, but for a variety of reasons failed to attend. Both groups started out with a very high interest in SEM fields, maintained or increased this interest from 1991 to 1994, chose an SEM field for a major approximately three times more frequently than the population overall, and elected to pursue SEM-related careers in substantial numbers. In addition, a large number will go on to pursue careers in the medical field, which many of the respondents feel is a choice of an SEM-related career.

Our major findings can be summarized as follows:

The YSP experience was a very positive one for the overwhelming majority of participants. They have gained awareness of a science-oriented community of professionals and high achieving students, have learned a good deal about various fields, and especially have learned about themselves and their professional interests. They have become more focused and more sure of themselves.

Table E-1
Demographic characteristics of participants and nonparticipants in weighted Westat samples

Characteristics	Participants (N=3,398)	Nonparticipants (N=6,231)
Percent in junior high (grades 7-9)	50	54
Percent in senior high (grades 10-12)	50	46
Percent female	56	56
In junior high	57	59
In senior high	54	53
Percent male	44	44
In junior high	43	41
In senior high	46	47
Percent African American	20	16
In junior high	32	19
In senior high	8	13
Percent white (non-Hispanic)	56	56
In junior high	47	56
In senior high	64	55
Percent other minorities[1]	24	23
In junior high	20	15
In senior high	28	32

[1] Asian American, Native American, Pacific Islander, Hispanic. See Technical Appendix, Table 5, for details.
SOURCE: *Short-Term Impact Study of Young Scholars Program*, National Science Foundation, 1994.

The students told us:

> *It was one of those experiences that you really never forget* (10th grade white male student).
>
> *The YSP gave me greater confidence, knowledge and overall it helped my self-esteem. I knew that I could fulfill my dream as a result* (8th grade Native American female student).
>
> *I experienced a different level of learning at the YSP that I had not experienced previously* (10th grade Hispanic male student).
>
> *It gave me the opportunity to do hands-on research and have a chance to try out something I was considering doing for a career* (11th grade white female student).
>
> *It was so superior an experience in every way that there is no comparison. I am truly grateful to the YSP and I do not know how much further I should go in giving it great kudos* (10th grade white male student).

The great majority of participants entered the program with a strong interest in science, engineering, and mathematics. This interest was further strengthened by the YSP experience, especially among junior high school students, for whom the effects were not only strong but also persistent. But interest in science is not a perfect predictor of career choice: our data show that it is compatible with anticipated careers as practitioners in the health professions and with careers in other fields. The majority of participants are indeed considering careers in SEM fields or the health professions. When asked about the extent to which these decisions had been influenced by the YSP experience, reinforcement of earlier choices and subfield selections were most often mentioned. There is no evidence that participation in YSP has had an impact on the SEM pipeline in terms of increasing potential recruitment of previously undecided students or of students who had considered careers in fields other than SEM or health.

Figure E-1 shows the actual and planned college majors of the participating and nonparticipating students. Figure E-2 shows the expected career choices for these same groups.

As these figures show, there is strong interest in SEM majors on the part of students from both groups. Of those currently enrolled in college, 65 percent of the participants and 72 percent of the nonparticipants indicate that they have chosen to major in the SEM fields. While these numbers are substantially larger than those reported for the population overall,[1] we can find no advantage for Young Scholars Program participants over those who applied to the program but did not attend.

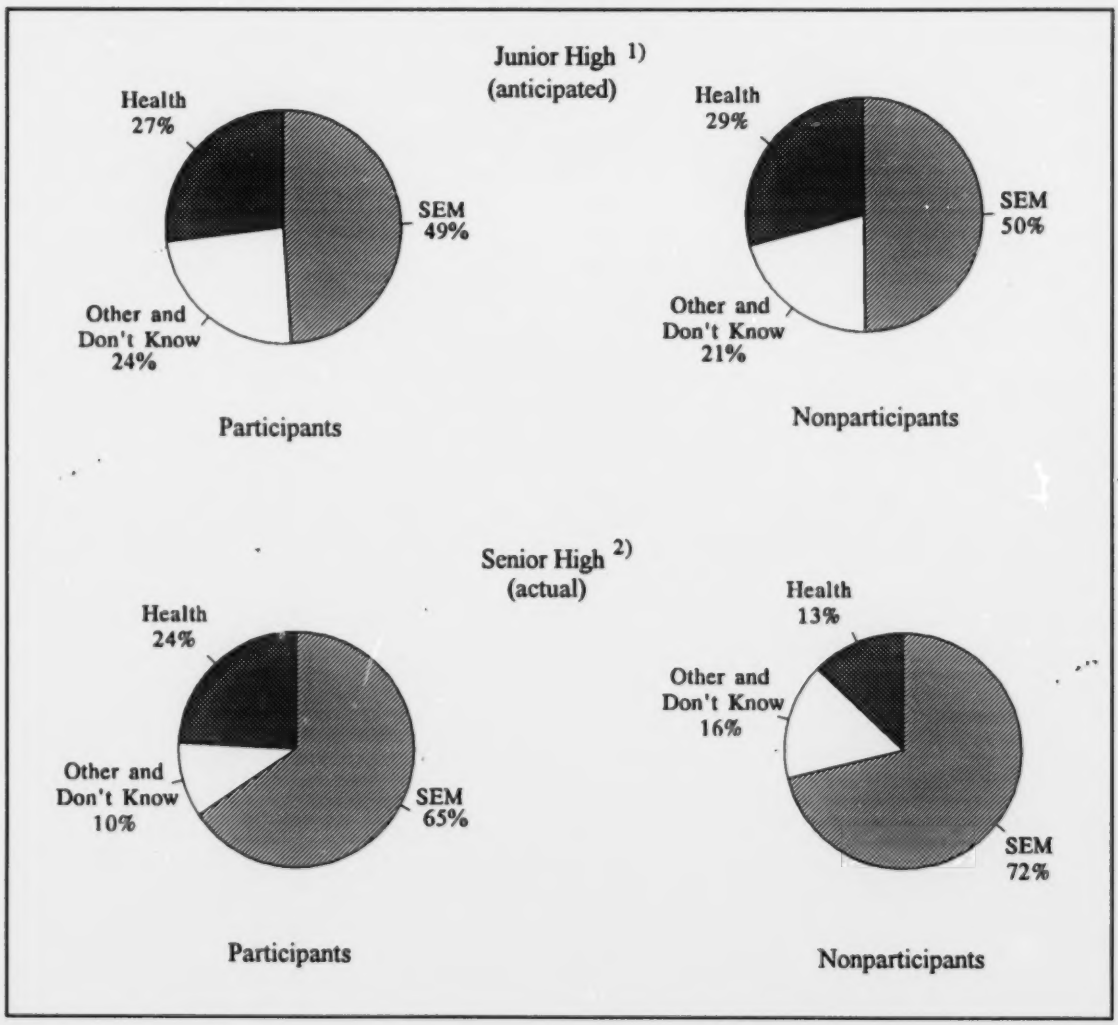
The picture with regard to career plans is very similar. Of those currently enrolled in college, 41 percent of the participants and 42 percent of the nonparticipants indicate that they plan to pursue a career in SEM fields.

The data also show that although our sample is thin with respect to gender and minority subgroups of participants, we can tentatively conclude that the program has been especially encouraging or reinforcing to African American students and least encouraging or reinforcing to females in their decisions to select careers in the SEM fields. Seventy-one percent of the participating African American students who are now in college plan a career in the SEM fields. Only 33 percent of the females indicate such a choice.

Taken together, these findings suggest that there is little evidence that participation in the Young Scholars Program, in and of itself, is a strong determiner of future pursuit of SEM careers. Rather, the program may better be described as one aspect of the mosaic of experiences that lead bright, motivated students to pursue advanced degrees and select challenging professional roles. Given the target

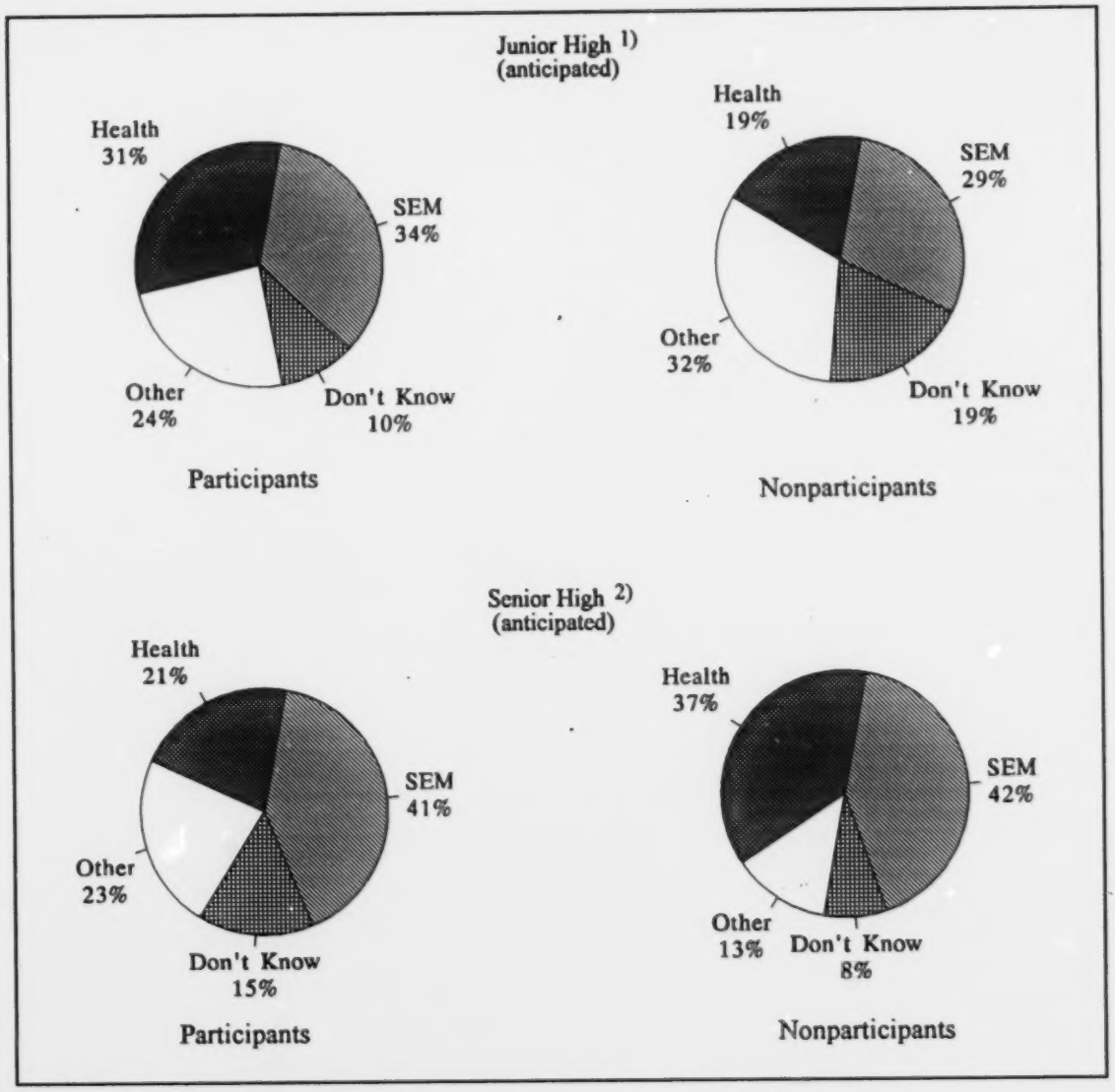
[1] See, for example, U.S. Department of Education, National Center for Education Statistics, *Digest of Education Statistics, 1993*, Table 207.

Figure E-1. Choice of college majors



SEM = science, engineering, and mathematics.
[1]1991 junior high school participants were in high school in 1994; their responses referred to planned college majors.
[2]1991 senior high school participants were in college in 1994; their responses referred to the actual majors they had chosen.
NOTE: Percentages may not add to 100 due to rounding.
SOURCE: *Short-Term Impact Study of Young Scholars Program*, National Science Foundation, 1994.

Figure E-2. Career plans



SEM = science, engineering, and mathematics.
[1]1991 junior high school participants were in high school in 1994.
[2]1991 senior high school participants were in college in 1994.
NOTE: Percentages may not add to 100 due to rounding.
SOURCE: *Short-Term Impact Study of Young Scholars Program*, National Science Foundation, 1994.

of the Young Scholars Program and the students that it attracts, it may be unrealistic to expect participation to have dramatic effects on their behaviors. They begin with a very proactive stance toward learning in general and science in particular. But the effects that were noted are not negligible: few of these science-oriented students have become discouraged by the real-world settings and tasks they have experienced, and many have further focused their interests and made valuable professional contacts. Refocusing this interest and contributing to their continued excitement as learners is an end of considerable merit.

The findings regarding African Americans and females are cause both for optimism and concern. The program clearly seems to have an especially reinforcing impact on African Americans. In contrast, while females are equally positive about the program and derive important networking opportunities from participation, they differ substantially in the ultimate selection of majors and careers in SEM-related areas. The limitations of our sample and the design of our protocols does not allow us to do more than touch the surface of both of these important findings. These are, however, areas that NSF might wish to look at more closely.

In addition, it is important to keep in mind that our examination of program impact looked across the program generally, sampling students from a wide diversity of programs, some of which may be stronger than others. Before drawing any conclusions about the efficacy of any particular effort, it would be important to look more closely at individual programs to see whether there are any systematic relationships between the characteristics of a particular program and the impacts found.

CHAPTER 1. INTRODUCTION

Background

The Young Scholars Program (YSP) was designed to excite students about science, engineering, mathematics and technology and to encourage them to investigate and pursue careers in these fields. The program targets bright, promising students, most of whom have a record of high achievement and an interest in science and science-related fields. Experiences offered to students are very diverse, including programs on university and college campuses, on research vessels and at archeological digs, at museums and zoological gardens, and in industry. The experiences vary in duration from 3 to 8 weeks and are generally held over the summer. Students may participate in more than one program, and in the same program for more than one summer.

Since 1988, a YSP longitudinal data base containing information on applicants and participants has been maintained by the COSMOS Corporation. Followup data on participants have been collected 1 year after their summer experience, and a second followup has been added recently. The data base and followup surveys provide some basic demographic data on students, as well as on a limited number of questions such as science and engineering courses taken in relevant fields, potential college majors, and the likelihood that students will select careers in science, engineering, or mathematics (SEM).

This data base, especially data collected on students who participated during the summer of 1991, has been used to provide some limited information on program impact.[2] In general, analyses using the data base show that positive attitudes toward, and interest in, SEM fields were maintained and even increased for program participants. The findings were similar regardless of race, gender, or socioeconomic status. The extent of this increase was, however, limited at least in part because of the initially high interest levels of the participants and a possible ceiling effect in the data. Further, because only about half of the original participants responded to the surveys, the generalizability of the findings is unclear. That is, it is possible that only those who maintained a relatively high interest in SEM chose to respond.

The purpose of the present study is to gather more comprehensive impact data on the Young Scholars Program. The study looks at students' perceptions of their experiences in the program, at the educational and career plans and choices of these students, and at the perceived impact of their experiences in the program on these choices. In addition, information was also collected from the parents of participants and from students who applied to, but did not attend, a Young Scholars Program in the summer of 1991.

Methodology

Sampling Procedures. With a goal of conducting interviews with 240 respondents, we drew an initial sample of 472 subjects from the Young Scholars Program data base. The large initial sample was used to allow for anticipated difficulties in locating and contacting a sizable proportion of these students.[3] Of the 285 students for whom we obtained data, 84 had been classified as nonparticipants in the COSMOS files. During our conversations, we found that 14 of these "nonparticipants" had actually participated in the YSP.[4] Thus, the final sample consisted of 215 participants and 70 nonparticipants.[5]

---

[2]Raber, Suzanne M. The Young Scholars Program: Attitudes of Secondary Students Toward Careers in Science and Mathematics Before and After Participating in an NSF Enrichment Program. Paper presented at the Annual Meeting of the American Educational Research Association, New Orleans, LA, April 8, 1994.

[3]In reality, we found that contacting students was far easier than we had expected. During the time allocated for data collection, conversations were conducted with over 60 percent of the initial sample, a total of 285 students.

[4]This was not unexpected as COSMOS reported to us that participant surveys are not submitted by approximately 20 percent of those who are actually served.

[5]A full discussion of sampling procedures and response rates will be found in the Technical Appendix.

Three other factors were considered in defining the sample. First, we sought to include a stratified sample of those who had responded to the 1993 followup study conducted by COSMOS and those who had not so that we could compare the two groups. Second, we looked at students' interest in becoming a scientist, engineer, or mathematician as reported in the earlier surveys analyzed by COSMOS staff.[6] Of central interest for our purposes was ensuring that our participant sample included individuals whose patterns of expressed career interest varied. Thus, we made sure that our sample incorporated those who had retained a high level of interest in entering such careers as reported in the 1993 followup survey, those whose interest had decreased, those whose interest had increased from application to the 1992 survey, and those who had indicated no interest in SEM careers at both times. Finally, we attempted to include roughly equal numbers of participants from grades 7 to 9 and 10 to 12.

It is also important to note that we made no attempt to do any sampling by program. Given our sample size, and the fact that somewhere between 6,000 and 7,000 students attend the program each summer, a wide variety and diversity of programs are represented in this study. Our findings, and the conclusions we draw, reflect the impact of the program overall but do not provide an accurate assessment of a particular program on its participants.

As explained in the Technical Appendix, prior to the analysis the data were weighted to reflect the actual distribution of subgroups in the total population of applicants and participants. Because of statistical considerations, we decided to exclude the 14 students originally classified as nonparticipants from the analyses based on weighted data. As shown in Table 1-1, the participant sample includes roughly the same numbers of students who had been in junior and in senior high school in 1991; among nonparticipants, the proportion of junior high school students is higher. As was the case for the entire population of applicants and participants, females compose a slightly higher proportion of the survey respondents than do males.[7]

In addition to student interviews, conversations were conducted with 52 parents of participants, and a special effort was made to reach parents of minority participants. Given the sample selection and the small number of conversations, these data have not been weighted and no quantitative analyses were carried out.

Data Collection. A telephone interview protocol was developed to guide the conversations. Although the exact questions varied from respondent to respondent, the menu of topics covered included the following:

For participants

- General impact of participating in a Young Scholars Program
- Opinions regarding the application process
- Current status of the participant
- College major (planned or actual) and plans for post-college education and careers
- Impact of YSP participation on career plans
- General reactions

For nonparticipants

- Reasons for nonparticipation
- Current status of the nonparticipant
- College major (planned or actual) and plans for post-college education and careers
- Career plans

[6] See, for example, U.S. Department of Education, National Center for Education Statistics, *Digest of Education Statistics, 1993*, Table 207.

[7] Raber, Susanne M., and Lanis B. Ossman. *Data Collection and Management for the Young Scholars Program: Additional 1991 Tabulations, Section III.* COSMOS Corporation, March 1993.

Table 1-1
Demographic characteristics of participants and nonparticipants in weighted Westat samples

Characteristic	Participants (N=3,398)	Nonparticipants (N=6,231)
Percent in junior high (grades 7-9)	50	54
Percent in senior high (grades 10-12)	50	46
Percent female	56	56
In junior high	57	59
In senior high	54	53
Percent male	44	44
In junior high	43	41
In senior high	46	47
Percent African American	20	16
In junior high	32	19
In senior high	8	13
Percent white (non-Hispanic)	56	56
In junior high	47	56
In senior high	64	55
Percent other minorities[1]	24	23
In junior high	20	15
In senior high	28	32

[1] Asian American, Native American, Pacific Islander, Hispanic. See Technical Appendix, Table 5, for details.
SOURCE: *Short-Term Impact Study of Young Scholars Program*, National Science Foundation, 1994.

Data Analysis

Approach. Our initial reading of the conversations pointed to considerable differences in the findings for students who were in junior high school at the time of participation and those who were in senior high school. In particular, the high school students were already in college when they were interviewed, most of them in their sophomore or junior year, and most had chosen their majors and made the career decisions that result from these choices. We therefore decided to analyze and present the data separately for the two grade levels throughout this report. For most topics, we also show findings separately for females and males. However, given the small number of cases on which the weighted data are based, it was neither appropriate to analyze data for all ethnic subgroups, nor could we provide a comprehensive analysis of gender within ethnic group; we therefore show data separately only for the African American and white subgroups.

Initially, we had also planned to look at the responses in terms of changes in expressed interest in a career in science. However, our conversations with students indicated that what is meant by "science" and a "career in science" varied considerably from student to student. (For example, some considered the medical professions to be a career in science; others did not.) And, it is unlikely that a common definition was shared by those initially classified into the same group. Given the uncertainty of what these responses from students really meant, we abandoned the analysis.

Finally, we also looked at whether or not response patterns varied by whether or not the participant had responded to the COSMOS 2-year followup survey. Interestingly, we were unable to find any differences between those who responded and those who did not with respect to

critical impact variables. We therefore combined these groups for analytic purposes.

Measuring Program Impact. The goal of the Young Scholars Program is to encourage, develop, or reinforce student interest in science, engineering, mathematics, and technology and to stimulate students' interest in pursuing careers in the SEM fields. One way to measure the extent to which the program is accomplishing this goal is to obtain the students' own assessment about the extent to which the program has stimulated or reinforced their interest in SEM. Another is to look at harder indicators, i.e., the extent to which participants have taken realistic steps toward the pursuit of SEM careers, which for students in this age group is reflected in the planned or actual selection of their college major, and for students approaching the end of their college years, in specific career plans or selection of fields of graduate or professional study.

One troubling issue in judging this outcome -- a familiar one to NSF policymakers -- is that the definition of "a career in SEM" is often perceived in ways that may not be congruent with the NSF mission. Thus, some students and parents felt that SEM careers were being pursued when students' high interest in mathematics and computers led to the choice of a college major in business or accounting and/or career choices in these fields. More frequently, many students and their parents see careers in one of the health occupations as careers in science. Thus, students who reported early interest in science and the strengthening of their interest through the YSP include high proportions who are interested in careers in nursing, medical practice, physical therapy, and other health professions, as well as others who are thinking about doing medical research.

In this report, we will be presenting both soft indicators (the students' self-assessment of the extent to which the program has affected their interest in SEM) and harder indicators about the students' study and career plans.

How This Report Is Organized. In Chapter 2, we present the data obtained from conversations with participants. Chapter 3 reports the findings for nonparticipants and, where possible, makes comparisons between outcome indicators (based on career choices and college majors) between participants and nonparticipants. Chapter 4 summarizes the largely qualitative analysis of our conversations with parents, and Chapter 5 presents our conclusions based on these findings. We have also included some suggestions for further research that might shed additional light on the impact of students' participation in the Young Scholars Program.

CHAPTER 2. CONVERSATIONS WITH PARTICIPANTS

General Impact of Participation

This section presents the participants' general reactions to their experiences in the Young Scholars Program. The opinions volunteered by the respondents leave no doubt that participation was a very positive experience for almost everyone.

Program Characteristics. The interviewer started the conversation with some questions about the program the participant had attended, its duration, and some of its features. The conversation then moved rapidly in the direction of opinions and attitudes: What were the best features of the program? How about the worst ones? What are adjectives that you would use to characterize the program? This first set of introductory, loosely structured questions set the tone for the interview and encouraged the free expression of comments, including those that were critical.

In the discussion about positive and negative aspects of the program, a wide range of best features and positive adjectives was offered, whereas many students could not think of anything negative to say. This was true of both the younger (grades 7-9 in 1991) and older (grades 10-12) participants. Positive features mentioned by both groups include their enjoyment of the field trips, hands-on activities, participation in experiments, and exposure to a college environment and laboratory facilities.

There were some differences in the opinions of the two groups, however. For example,

- While both groups singled out the quality of the instruction and the opportunity to meet other students and spend time with them as best features, younger students most often mentioned this social aspect, whereas older students were most likely to talk about the high quality of the instructors.
- Younger respondents were somewhat more likely to talk about becoming more confident about science and computers, whereas the older group spoke about specific pieces of scientific equipment or research projects and presentations by outside speakers.

But there can be no doubt that both groups derived a great deal of stimulation from their campus experience.

It is notable that over one-fifth of respondents in both groups could not think of a single "worst" aspect; of those who could, the largest number felt that the program was too short; a few thought it was too long or too difficult. Many of the complaints dealt with nonacademic matters: hot classrooms, poor air conditioning, bad food, curfew regulations. But there were also some complaints about specific classes, lack of structure, and too much sitting and listening.

The following are some typical comments:

> *It was one of those experiences that you really never forget* (10th grade white male student).
>
> *The YSP gave me greater confidence, knowledge and overall it helped my self-esteem. I knew that I could fulfill my dream as a result* (8th grade Native American female student).
>
> *I experienced a different level of learning at the YSP that I had not experienced previously* (10th grade Hispanic male student).
>
> *It gave me the opportunity to do hands-on research and have a chance to try out something I was considering doing for a career* (11th grade white female student).

> *It was so superior an experience in every way that there is no comparison. I am truly grateful to the YSP and I do not know how much further I should go in giving it great kudos* (10th grade white male student).

The very positive overall assessment by these participants is further reflected in their choice of adjectives to characterize the program: "fun" was the first choice of both groups, with 28 percent of the younger group and 19 percent of the older group offering this choice. "Educational" was a strong second, and "good" was third. Only a handful of respondents came up with a negative characterization (boring, exhausting, scary, disorganized).

Comparing the YSP Program with School Experience. Further confirmation of the positive feelings toward the program were also found when the respondents were asked to compare the YSP experience with that of coursework taken in science and math during the school year (Table 2-1). The most frequent comments related to the observation that instruction had more depth and more breadth. Students also commented about the greater use of hands-on activities and the higher quality of teachers.

African American students who were in high school when they participated mentioned "better teachers" most often; they also often mentioned the difficulty of YSP compared to their regular coursework.

Table 2-1
Comparison of YSP experience with coursework

Answer	Junior high students (grades 7-9)					Senior high students (grades 10-12)				
	Female (N=977)	Male (N=727)	African American (N=560)	White (N=808)	Total[1] (N=1,704)	Female (N=921)	Male (N=773)	African American (N=132)	White (N=1,086)	Total[1] (N=1,694)
	(percent)					(percent)				
Better teachers	3	10	13	0	6	9	26	37	18	17
More hands-on	22	21	23	27	22	20	12	26	16	16
More teacher-student interaction	8	2	10	0	5	1	0	0	1	*
More depth; more sophisticated	18	29	38	14	23	17	19	5	18	18
YSP more difficult	4	3	1	6	4	3	8	26	3	5
More emphasis on thinking, problem solving	0	0	0	0	0	3	4	0	3	3
Other[2]	43	36	15	52	40	47	31	7	43	40
Don't know	1	0	0	2	1	0	0	0	0	0

*Denotes a number less than .5 percent and greater than 0 percent.

[1]Includes minority groups not included in table.

[2]Sample responses classified as other are "everyone there wanted to be there," "more interesting," and "there is no comparison."

NOTE: Percentages may not add to 100 due to rounding.

SOURCE: *Short-Term Impact Study of Young Scholars Program*, National Science Foundation, 1994.

BEST COPY AVAILABLE

Long-Term Connections Established Through YSP. We also looked at the extent to which close association between staff and students and among the students themselves, a frequent characteristic of these programs, leads to strong mentoring relationships and networks. The findings suggest that this was indeed the case for about half of the participants with respect to staff, and that about half of these relationships lasted beyond the life of the program.

As shown in Tables 2-2 and 2-3, there were some differences depending on respondents' ethnicity and gender: African American students were more likely to report continuing relationships with staff, and females most often remained in contact with adult mentors after the program ended. With respect to networks among students, about three-fourths of the participants indicated that such networks had, in fact, been established. In many cases, these were primarily social, but for some students, especially those who had been in the upper grades at the time they participated, this networking included exchanging correspondence, some by E-mail, on SEM subjects of common interest; others found themselves at the same college or university as a fellow participant.

Continued networking with other participants was consistently higher for females than for males and for African Americans than for whites. For females, this difference is especially large at the 10-12 grade level, where 83 percent of the females compared to 64 percent of the males indicated that networks were established.

Analysis by racial group shows that the difference between African Americans and whites is most prominent with regard to the establishment of continuing networks -- 25 percent versus 5 percent for grades 7-9 and 21 percent versus 9 percent for grades 10-12.[8]

Would Respondent Again Participate in a Young Scholars Program? Although this question is likely to be interpreted differently by younger respondents (those still in high school when they were interviewed) and older students, it provides some indication of their feelings about the program. As one might expect from the earlier data in this section, the response was a resounding "yes." Of those who discussed this topic, 86 percent in the grades 10-12 group and 92 percent in the grades 7-9 group answered yes; the others were more likely to answer "maybe, it depends" rather than "no."

Table 2-2
Did participants establish any significant (mentoring) relationships with adults through the Young Scholars Program?

Answer	Junior high students (grades 7-9)					Senior high students (grades 10-12)				
	Female (N=977)	Male (N=727)	African American (N=560)	White (N=808)	Total[1] (N=1,704)	Female (N=870)	Male (N=733)	African American (N=132)	White (N=1,085)	Total[1] (N=1,643)
	(percent)					(percent)				
No	43	43	32	49	43	46	57	44	52	51
Yes, but only while program lasted	7	22	25	3	13	12	11	9	15	11
Yes, beyond program	36	22	23	34	30	33	16	23	20	25
Yes, no further information	14	14	21	15	14	9	13	23	11	11
Don't know	0	0	0	0	0	0	4	0	3	2

[1]Includes minority groups not included in table; excludes "no answer" to question.
NOTE: Percentages may not add to 100 due to rounding.
SOURCE: *Short-Term Impact Study of Young Scholars Program*, National Science Foundation, 1994.

[8]It would be very interesting to look at this finding by gender within race given the gender results for the overall population. Unfortunately, our sample size does not permit this level of disaggregation.

Table 2-3
Did participants establish any networks with other participants?

Answer	Junior high students (grades 7-9)					Senior high students (grades 10-12)				
	Female (N=971)	Male (N=727)	African American (N=559)	White (N=808)	Total[1] (N=1,698)	Female (N=921)	Male (N=733)	African American (N=132)	White (N=1,086)	Total[1] (N=1,694)
	(percent)					(percent)				
No	22	28	14	32	25	17	36	25	32	26
Yes, only social	2	4	7	2	3	4	17	7	6	10
Yes, SEM-related for a short time	1	0	0	1	*	1	0	0	1	1
Yes, SEM-related for a long time	16	10	25	5	13	9	7	21	9	8
Yes, no further information	60	55	53	59	57	66	37	47	47	53
Yes, other	0	3	1	2	1	3	3	0	5	3

* Denotes a number less than .05 percent and greater than 0 percent.
SEM = science, engineering, and mathematics.
[1]Includes minority groups not included in table; excludes "no answer" to question.
NOTE: Percentages may not add to 100 due to rounding.
SOURCE: *Short-Term Impact Study of Young Scholars Program*, National Science Foundation, 1994.

Have Participants Recommended the Program to Other Students? Perhaps a better measure of the students' assessment of their program experience can be found in the answers to this question. Four out of five participants among both junior high and senior high students claim to have done so; some mentioned specifically that they had urged their friends or younger siblings to apply.

The Application Process

A second topic dealt with how the students heard about the YSP program that first they attended. Who influenced their decision to apply? How did they feel about the application process? We talked about this topic with the participants to find out how eligible students become aware of these programs and to investigate the extent to which schools and parents play a role in application decisions. Our findings show that school staff are the principal informants, but that staff and parents play significant roles in the decision process.

Awareness of YSP. As shown in Table 2-4, school staff, especially classroom teachers, are by far the most frequent source of information about the program: 43 percent of junior high school students and 58 percent of those who were in senior high school named a teacher as their most frequent source. Other school staff, especially counselors, and for a small number of junior high school students, the principal, are also important sources. The family is a distant third, especially at the senior high school level. Within the family, it is the mother more often than the father who knows about the program; this may be due in part to the absence of fathers in some of the students' homes, and in part because mothers who are employed as teachers are knowledgeable about opportunities for summer study programs.

The Decision To Apply. Teachers are also most frequently mentioned as having encouraged the students to apply to the program, but the role of the family, and especially that of the mother, is also crucial.[9] The data presented in Table 2-5 suggest that there is an especially important role played by the mothers of females and of African American students. Forty-two percent of the African Americans from grades 7-9 and 44 percent of those from grades 10-12 indicated encouragement from their mothers. (The comparable figures for whites are 27 percent and 12 percent.)

[9]For one thing, parental approval is an essential precondition for submitting the application, since participation usually entails some financial expenditures or loss of summer earnings for the student, requires time commitments (if students need transportation), and may interfere with a family's other summer plans or needs.

Table 2-4
How participants learned about the Young Scholars Program (first source mentioned)

Source	Junior high (grades 7-9) (N=1,704)	Senior high (grades 10-12) (N=1,667)
	(percent)	
Teacher	43	58
School counselor	21	18
Mother	9	3
Father	3	2
Sibling, other relative	5	1
Friend	5	5
Other[1]	13	9
Do not remember	0	4

[1]Includes other sources mentioned by fewer than 2 percent of participants: principal, posters, pamphlets, brochures, projects, mail, the National Science Foundation, the Young Scholars Program coordinator, newspapers, television, National Merit, minority fair, being a prior awardee.
NOTE: Percentages may not add to 100 due to rounding.
SOURCE: *Short-Term Impact Study of Young Scholars Program*, National Science Foundation, 1994.

Table 2-5
Who encouraged participant to apply?

Answer	Junior high students (grades 7-9)					Senior high students (grades 10-12)				
	Female (N=977)	Male (N=695)	African American (N=527)	White (N=808)	Total[1] (N=1,704)	Female (N=921)	Male (N=733)	African American (N=132)	White (N=1,086)	Total[1] (N=1,694)
	(percent)					(percent)				
Teacher	34	39	20	37	36	55	39	30	53	48
School counselor	7	12	18	4	9	8	12	5	11	10
Mother	34	24	42	27	30	12	17	44	12	15
Father	5	4	4	7	5	6	4	0	5	5
Self	10	7	6	13	9	10	21	21	12	15
Sibling, other relative	1	9	6	4	4	1	4	0	1	2
Friend	4	3	1	7	4	6	*	0	5	3
Principal	1	0	0	2	1	0	0	0	0	0
Other	5	1	3	0	3	3	3	0	2	3

*Denotes a number less than .5 percent and greater than 0 percent.
[1]Includes minority groups not included in table; excludes "no answer" to question.
NOTE: Percentages may not add to 100 due to rounding.
SOURCE: *Short-Term Impact Study of Young Scholars Program*, National Science Foundation, 1994.

About half of all participants mentioned that more than one person had encouraged them: teachers, mothers, and fathers were most frequently mentioned in second or third place. From the interviews with parents (see Chapter 4), there is considerable evidence that parents indeed provided not only encouragement, but also help; they secured application forms, which were not always available in the schools, and made sure that applications were actually completed and mailed. From our interviews with parents, we noticed that this was most often the case for junior high school students; parents of high school students more often left decisions and paperwork up to their children. This is again confirmed by our data, with a sizable number of older (high school) students stating that the decision had been strictly their own: 21 percent of the males and of the African Americans indicated that they did not seek or receive encouragement from anyone, but acted on their own.

The Application Process. The application process itself was not a very salient issue for most applicants; the majority either did not remember much about it or could not identify specific features to praise or criticize. A few respondents mentioned the essays, either as strong or weak features, with the majority opting for the strong category. Similarly, the need for teacher recommendations was occasionally mentioned; some respondents found it difficult to obtain the cooperation of busy teachers. Others liked the highly selective nature of the program, since it was another way of ensuring the predominance of qualified participants, which they felt was one of the strengths of the program they had attended. It would seem that a personal interview was required by some programs and not by others. Most often, the interview was seen as one of the best features, and very few respondents mentioned it as a negative aspect of the application process. There were a few complaints about fees, the long wait before learning about acceptance, and the fact that the program seemed to discriminate in favor of specific minority groups.

Current Status and Current Plans for Further Education and for Careers

Current Status. The participants who were in junior high school at the time they participated in the program were either still in high school or had just completed the 12th grade when we spoke with them. Those who were in high school in 1991 had completed their sophomore or junior year of college. In our conversations with all students we discussed college majors and long-term career objectives.

Further Education. Not surprisingly, all the participants in the Young Scholars Program are committed to furthering their education and have elected to, or planned to pursue their education through the postsecondary years and beyond. Table 2-6 shows that the vast majority of these older participants (96 percent) were either in college at the time of our conversations or planned to enroll. Among the older students, those who were not in college were either working full time (all of these were females) or had enlisted in the military.

Table 2-6
1994 status of 1991 participants

In grades 7-9 in 1991	Female (N=977)	Male (N=727)	African American (N=560)	White (N=808)	Total[1] (N=1,704)
			(percent)		
Completed 10th grade	45	30	50	33	39
Completed 11th grade	48	46	36	54	47
Completed 12th grade	3	15	3	8	8
In college	*	4	6	0	2
Other	4	4	6	4	4
In grades 10-12 in 1991	**Female (N=921)**	**Male (N=773)**	**African American (N=125)**	**White (N=994)**	**Total[1,2] (N=1,650)**
			(percent)		
College, Year 1	1	0	7	*	1
College, Year 2	27	40	41	29	33
College, Year 3	59	53	52	60	57
College, Year 4	6	4	0	5	5
Working, not in college	6	0	0	5	3
In military	0	3	0	0	1

*Denotes a number less than .5 percent and greater than 0 percent.

[1]Includes minority groups not listed in table; excludes "no answer" to question.

[2]Numbers for females and males do not add to total because of missing data.

NOTE: Percentages may not add to 100 due to rounding.

SOURCE: *Short-Term Impact Study of Young Scholars Program*, National Science Foundation, 1994.

The younger participants planned to enroll in college at about the same rate as the older participants had done (Table 2-7). (We are not discussing data by grade level for other ethnic minorities because we do not have adequate numbers in our sample.) The small proportion of respondents who did not indicate that they planned to go to college were either undecided or thought they would enlist in the military.

Table 2-7 also presents the older students' plans for graduate education (younger students were not asked about planned graduate study). These data again show that Young Scholars participants have a very significant commitment to advanced education. The majority of students who had been in grades 10-12 at the time they participated in the YSP and were now in college said they were likely to go beyond the bachelor's degree. The data further show that

- Plans for graduate education were mentioned most frequently by African American students, 73 percent of whom had plans for immediate further study after college.
- Only 53 percent of white students had such plans; they were more likely to plan to go to work. It is likely that more of the white students planned to work after college because more of them had majored in engineering, a field where the undergraduate degree is often a sufficient credential for professional employment.
- Females were somewhat less likely than males to express graduate school intentions (55 percent versus 65 percent), and more females planned to work (36 percent versus 20 percent of the males); this may also be related to the college major, since close to 9 percent of the females were majoring in education.
- The most frequently mentioned graduate field was health professions (Table 2-8).

Table 2-7
Plans for future education

Junior high students (grades 7-9)	Female (N=977)	Male (N=727)	Total (N=1,704)	African American (N=560)	White (N=808)	Total[1] (N=1,705)
			(percent)			
College	94	96	95	92	99	95
Work	0	0	0	0	0	0
Military	1	4	3	8	0	3
Don't know	5	0	3	0	2	3
Senior high students (grades 10-12)	**Female (N=839)**	**Male (N=721)**	**Total (N=1,560)**	**African American (N=132)**	**White (N=1,003)**	**Total[1] (N=1,560)**
			(percent)			
Graduate school	55	65	60	73	53	60
Work	36	20	29	25	36	29
Other[2]	8	3	5	2	4	5
Don't know	1	12	6	0	7	6

[1]Includes minority groups not listed in table; excludes "no answer" to question.

[2]Includes military, housewife, missionary work, and voluntary service.

NOTE: Percentages may not add to 100 due to rounding.

SOURCE: *Short-Term Impact Study of Young Scholars Program*, National Science Foundation, 1994.

Table 2-8
Participants' plans for field of graduate study[1]

Field of study	Female (N=464)	Male (N=439)	African American (N=96)	White (N=505)	Total[2] (N=903)
	(percent)		(percent)		
Biological and Life Sciences	11	1	0	10	6
Computer and Information Sciences	0	5	0	5	3
Engineering and Engineering Technologies	18	20	25	21	19
Mathematics	6	0	25	1	3
Chemistry	0	5	0	0	3
Physics	0	5	0	0	3
Other SEM	3	0	3	2	1
Undecided (including SEM)[3]	10	19	29	11	14
Total SEM fields	48	55	82	50	52
Health Professions	24	33	18	33	28
Education	1	0	0	1	*
Architecture and Environmental Design	0	2	0	2	1
Business and Commerce	3	6	0	7	5
Other non-SEM	9	3	0	4	6
Undecided - not SEM	6	0	0	0	3
Total other fields	42	44	18	47	43
Don't know	10	0	0	5	5

*Denotes a number less than .5 percent and greater than 0 percent.

SEM = science, engineering, and mathematics.

[1]Based on students who planned to go to graduate school and who were in grades 10-12 when they participated in the Young Scholars Program and in college when they were interviewed in 1994.

[2]Includes minority groups not listed in table; excludes "no answer" to question.

[3]Includes students who were considering several fields and indicated that at least one of them was in SEM.

NOTE: Percentages may not add to 100 due to rounding.

SOURCE: *Short-Term Impact Study of Young Scholars Program*, National Science Foundation, 1994.

College Major. One of the most important outcome indicators to examine for an assessment of the YSP is the students' choice of college major. If a student majors (or plans to major) in one of the SEM fields, there is no guarantee that he or she will become a scientist, engineer, or mathematician; but if the undergraduate major is not in one of the SEM fields, it is unlikely that the student will be able to become a scientist, engineer, or mathematician. Table 2-9 shows that among those students still in high school, 45 percent were planning to major in one of the SEM fields; we have included here students who said they were undecided, but indicated that at least one of their choices was an SEM field. Among those students actually in college, the proportion was considerably higher (65 percent). The proportion of students majoring or planning to major in one of the SEM fields is somewhat higher for males than for females, and somewhat higher for whites than for African Americans (Table 2-10). Possible explanations for the differences in selection of SEM majors by junior and senior high schools students may be greater interest in YSP by the older SEM-oriented students, or greater selectivity by YSP when accepting students at that grade level.

We have sought to compare the major choices of the YSP participants now in college with the total population of U.S. students. The latest available data for the U.S. are for 1989. It can be seen that among the YSP participants now in college, those who are majoring in engineering,

Table 2-9
Choice of college major (actual or anticipated) of participants, by gender

Major	Junior high students (grades 7-9)			Senior high students (grades 10-12)		
	Female (N=920)	Male (N=662)	Total (N=1,582)	Female (N=866)	Male (N=749)	Total (N=1,615)
	(percent)			(percent)		
Agriculture and Natural Resources	0	2	1	0	0	0
Biological and Life Sciences	8	0	5	17	6	12
Computer and Information Sciences	0	1	*	0	7	3
Engineering and Engineering Technologies	16	42	27	19	37	27
Mathematics	1	0	1	9	0	5
Chemistry	0	1	1	3	3	3
Earth Sciences	0	0	0	0	*	*
Physics	1	0	*	0	7	3
Social Sciences	0	1	*	4	1	2
Other SEM	1	8	4	9	10	10
Undecided (including SEM)[1]	3	10	6	0	0	0
Total SEM fields	30	65	45	61	71	65
Health Professions	25	12	20	7	12	9
Education	5	0	3	6	0	3
Architecture	0	5	2	3	1	2
Business and Commerce	0	0	0	5	5	5
Language and Literature	0	0	0	3	0	2
Communications	4	0	2	2	0	1
Other non-SEM	12	10	11	10	4	8
Undecided-not SEM	17	7	13	3	4	3
Total other fields	63	34	51	39	26	33
Don't know	7	1	4	0	3	1

*Denotes a number less than .05 percent and greater than 0 percent.

SEM = science, engineering, and mathematics.

[1]Includes students who were considering several majors and indicated that at least one of them was in SEM.

NOTE: Percentages may not add to 100 due to rounding.

SOURCE: *Short-Term Impact Study of Young Scholars Program*, National Science Foundation, 1994.

Table 2-10
College major (anticipated and actual) of participants, by gender and ethnicity (grouped data)

Major[1]	Junior high students (grades 7-9)					Senior high students (grades 10-12)				
	Female (N=920)	Male (N=662)	African American (N=515)	White (N=764)	Total[2] (N=1,582)	Female (N=866)	Male (N=749)	African American (N=132)	White (N=1,031)	Total[2] (N=1,615)
	(percent)					(percent)				
Engineering and Eng. Technologies	16	42	24	27	32	19	37	21	34	38
Other SEM	14	22	10	24	17	42	34	49	31	27
Health Professions	25	12	15	17	27	7	12	0	11	24
All other fields	38	23	51	26	20	32	14	30	21	9
Don't know	7	1	0	7	4	0	3	0	2	1

SEM = science, engineering, and mathematics.
[1]See Table 2-9 for fields included in each group.
[2]Includes minority groups not included in this table; excludes "no answer" to question.
NOTE: Percentages may not add to 100 due to rounding.
SOURCE: *Short-Term Impact Study of Young Scholars Program*, National Science Foundation, 1994.

Table 2-11
College major of YSP participants now in college and all U.S. students in 4-year colleges in 1989

Major	Percent of Westat grade 10-12 sample[1] (N=1,591)	Percent of all U.S. students[2,3] (N=4,088,900)
Agriculture and Natural Resources	0	1
Biological and Life Sciences	12	5
Computers and Information Sciences	3	3
Engineering and Engineering Technologies	28	9
Mathematics	5	1
Other SEM	16	1
Social Sciences	3	11
Health Professions	9	9
Education	3	8
Architecture	2	2
Business and Commerce	5	22
Language and Literature (English)	2	4
Communications/Journalism	1	3
Other non-SEM	11	20

SEM = science, engineering, and mathematics.
[1]Excludes students whose response was "don't know."
[2]Excludes students whose major was not listed or who did not report a major.
[3]U.S. Department of Education, National Center for Education Statistics, *Digest of Education Statistics: 1993*, Table 207.
NOTE: Percentages may not add to 100 due to rounding.
SOURCE: *Short-Term Impact Study of Young Scholars Program*, National Science Foundation, 1994.

Table 2-12
Career plans of participants, by gender and ethnicity

Career	Junior high students (grades 7-9)					Senior high students (grades 10-12)				
	Female (N=977)	Male (N=695)	African American (N=560)	White (N=776)	Total[1] (N=1,672)	Female (N=918)	Male (N=773)	African American (N=132)	White (N=1,083)	Total[1] (N=1,691)
	(percent)					(percent)				
Engineering	7	35	33	12	19	15	28	21	27	21
Computer Technology	0	0	0	0	0	3	10	39	4	6
Other SEM	14	17	3	20	15	15	13	21	13	14
Health Professions	38	21	16	31	31	24	18	13	21	21
Elementary/Secondary Teacher - Math or Science	0	0	0	0	0	6	3	0	5	5
Elementary/Secondary Teacher - Other field or field not identified	6	0	8	2	3	3	0	0	0	1
Business	1	5	6	1	3	5	5	0	7	5
Law	4	1	7	1	3	7	0	0	2	4
Other, not SEM	19	10	26	15	15	9	7	7	9	8
No plans	1	0	0	1	*	4	4	0	4	4
Don't know	9	10	2	17	10	10	11	0	8	11

* Denotes a number less than .05 percent and greater than 0 percent.
SEM = science, engineering, and mathematics.
[1] Includes minority groups not included in table.
NOTE: Percentages may not add to 100 due to rounding.
SOURCE: *Short-Term Impact Study of Young Scholars Program*, National Science Foundation, 1994.

mathematics, computers and information sciences, or one of the physical and life sciences outnumber the proportion among all college students by more than three to one (Table 2-11).[10]

Career Plans. The data on career plans are more ambiguous. Far fewer students plan to become scientists, engineers, and mathematicians than one might have anticipated from the majors they had selected. However, many planned to pursue careers in related fields. Table 2-12 shows that only 34 percent of the junior high and 41 percent of the senior high school participants plan to enter SEM careers; the proportions are considerably higher for males and for African Americans. The proportion of students with plans for careers in the health professions is very high, and as we have previously discussed, depending on one's definition, these can be seen as science careers. (We cannot judge from our interview data how many students are thinking about medical research or planning to become practitioners such as physicians and nurses.) Interest in career choices in the medical field is also evident from students' choices of graduate study fields, where health professions was the field most often mentioned (Table 2-8). But other career choices were also reported, often by students who expressed considerable interest in science. For example, 9 percent of the females now in college are planning to become elementary or secondary school teachers; law is another field more often mentioned by females now in college than by those still in high school. Five percent of the males now in college are planning to go into business fields; some mentioned the computer field and/or indicated that they planned to become self-employed in the computer field.

The great majority of participants (about 70 percent overall) indicated that their career plans were very firm or firm. As might be expected, plans were somewhat firmer for the older students in this group; the proportions were

[10] This excludes social sciences, but this category includes a mixture of majors that could be considered both SEM and non-SEM.

highest among males and African Americans, and lowest among females.

Tables 2-13 and 2-14 show the career choices by students who anticipate majoring or are majoring in various fields. Some highlights of these findings follow:

- All the younger students and most of the other students with majors (or anticipated majors) in the health professions also plan health careers.

Table 2-13
Career plans (by major or anticipated major) of participants, by gender

Career	Grades 7-9 (N= 1,483)							
	Major							
	Engineering		Other SEM		Health Professions		All other fields	
	Female	Male	Female	Male	Female	Male	Female	Male
	(percent)							
Engineering	37	69	0	23	0	0	0	16
Other SEM	44	20	46	46	0	0	3	0
Health Professions	0	0	36	31	100	100	8	18
All other fields	4	0	5	0	0	0	83	66
Don't know	15	12	14	0	0	0	5	0
	Grades 10-12 (N= 1,588)							
Engineering	69	69	8	0	0	0	0	0
Other SEM	0	21	28	44	0	0	21	9
Health Professions	0	0	49	11	59	100	2	0
All other fields	15	0	12	34	0	0	74	91
Don't know	17	10	3	11	41	0	2	0

Table 2-14
Career plans (by major or anticipated major) of participants, by ethnicity

Career	Grades 7-9 (N= 1,550)							
	Major							
	Engineering		Other SEM		Health Professions		All other fields	
	African American	White	African American	White	African American	White	African American	White
	(percent)							
Engineering	95	46	62	0	0	0	8	0
Other SEM	0	27	15	53	0	0	2	4
Health Professions	0	0	23	40	100	100	0	4
All other fields	5	0	0	3	0	0	85	89
Don't know	0	27	0	3	0	0	5	4
	Grades 10-12 (N= 1,612)							
Engineering	100	76	0	8	0	0	0	0
Other SEM	0	10	85	34	0	0	60	19
Health Professions	0	0	15	34	0	79	17	0
All other fields	0	7	0	22	0	0	23	77
Don't know	0	8	0	1	0	21	0	3

SEM = science, engineering, and mathematics.

NOTE: Percentages may not add to 100 due to rounding.

SOURCE: *Short-Term Impact Study of Young Scholars Program*, National Science Foundation, 1994.

Table 2-15
Percentage of participants reporting *very strong* interest in science at 3 points in time

Time	In grades 7-9 in 1991					In grades 10-12 in 1991				
	Female (N=969)	Male (N=695)	African American (N=560)	White (N=768)	Total[1] (N=1,664	Female (N=894)	Male (N=759)	African American (N=125)	White (N=1,055)	Total[1] (N=1,657)
	(percent)					(percent)				
Before YSP	71	73	74	70	72	80	89	79	87	84
Immediately after YSP (1991)	91	95	93	96	93	93	98	100	97	95
At present (1994)	91	95	93	94	93	80	93	93	88	86

[1]Numbers of participants are for the 1994 data point. Numbers for other data points may vary slightly because of missing data. Total numbers include minority groups not included in tables; excludes "no answer" to question.

SOURCE: *Short-Term Impact Study of Young Scholars Program*, National Science Foundation, 1994.

- Engineering majors also most often plan to work in engineering or in other SEM fields (in particular, computer technology), but a fairly high proportion are undecided.
- Quite a few male students who major in "other SEM fields" plan to work in health fields; many of these are majoring in biological and life sciences at the undergraduate level.
- Most of those students who did not major in engineering, other SEM fields, or health professions did not expect to move into these career fields, although some of them do plan to do so.

The Impact of YSP

At various points in the conversations, we sought to elicit the participants' view of the impact of the YSP on their subsequent academic and career decisions. This was not an easy task. For example, we had hypothesized that after participating in the program, some students might be more likely to have elected additional or more advanced courses in mathematics and/or science during their remaining precollege years. This was not a fruitful effort: most junior high school students indicated that all their courses were required by the curriculum, or that they were further constrained by the availability of offerings in the high schools they subsequently attended. For the older students, many of them in the second year of college, the question seemed largely irrelevant.

On the other hand, we were somewhat more successful with questions that were intended to explore the students' interest in SEM at various points in time. As shown in Table 2-15, the YSP increased this interest for the overwhelming majority of participants, regardless of gender or ethnicity, although the increase was strongest for males and white participants and least persistent for females. It was especially strong and persistent for junior high participants. But as Raber pointed out,[11] ceiling effects are very strong: over 70 percent of those who applied and participated in this program had a very strong interest in science prior to participation.

Apparently these students saw no inconsistency between interest in science and choice of careers that do not fit the SEM classification.[12]

When we discussed the impact of the program on the choice of SEM careers, few students addressed this topic in a clear-cut manner, except for those who said it had no impact because their plans were firm. A few students, especially in the younger group, indicated that they had no

[11]Raber, Susanne M. The Young Scholars Program: Attitudes of Secondary Students Toward Careers in Science and Mathematics Before and After Participating in an NSF Enrichment Program. Paper presented at the Annual Meeting of the American Educational Research Association, New Orleans, LA, April 8, 1994.

[12]We have shown that even if we include all persons who plan to enter the health fields as electing SEM occupations (thus stretching the definition beyond its usual meaning), there are clearly a good many young people who are very interested in science but do not intend to enter this career field.

idea what careers in SEM, and especially engineering, were really like, and now that they found out, they would consider them:

> *Prior to YSP, I didn't know what engineering was all about* (8th grade white female student).

> *I was pretty directionless and the YSP pointed me into a biology field and that's where I still am* (9th grade female, ethnicity unknown).

But more often, students became aware of their interests in a different SEM field or subfield from the one they had thought about earlier:

> *Shifted interested from math to science* (9th grade white male student).

Most often, the participants talked in more general terms about the impact of the YSP on their confidence to tackle SEM, of having gained a better understanding of what the work was like and what was required by way of background knowledge, and of becoming aware of opportunities in these fields:

> *The YSP made me a positive person. It gave me so much positive thinking for my future and my life* (11th grade Hispanic female student).

> *It gave me a sense of confidence in my own abilities in science* (9th grade African American female student).

> *The program showed me that competition exists but that I have the competitive skills needed* (9th grade Hispanic male student).

On the other hand, there is no doubt that the reality testing that the YSP provided for participants might discourage some participants, and here and there we found some evidence of this: a few participants did not like the number crunching, hard work, or monotony that they saw as characteristic of SEM careers. But as Table 2-16 shows, such respondents were a minority.

We had also hypothesized that their decision to elect SEM careers might have been influenced by what participants learned during program participation about future job opportunities and the extent to which they themselves would fit into the field. Although we have not fully explored the data with respect to these issues, at first glance they do not appear decisive, since the great majority of all respondents held optimistic views of job opportunities and especially of their own prospects for succeeding and fitting in well. But in both groups, females and African Americans were often less positive than males and whites (Table 2-17). While some respondents were able to point to specific YSP elements that had helped them to assess job prospects and the likelihood that they would fit into these professions (faculty were usually mentioned), many more cited the increase in their self-confidence and their congenial relations with students of similar interest as important factors.

Putting It All Together

From the information that we have presented in this chapter, we can point to three major findings:

- The YSP experience has been a very positive one for the overwhelming majority of participants. They have gained awareness of a science-oriented community of professionals and high achieving students, have learned a good deal about various fields, and, especially, have learned about themselves and their professional interests. They have become more focused and more sure of themselves.
- The great majority entered the program with a strong interest in science and mathematics. The majority of them -- but especially those who are now in college -- are considering careers in SEM fields or in the health professions, which many of them view as scientific careers. For most, these decisions were not determined by YSP participation, although the program may have reinforced decisions, especially

Table 2-16
Impact of YSP on career plans

Impact	Junior high students (grades 7-9)					Senior high students (grades 10-12)				
	Female (N=945)	Male (N=695)	African American (N=527)	White (N=776)	Total[1] (N=1,640)	Female (N=870)	Male (N=773)	African American (N=132)	White (N=1,034)	Total[1] (N=1,643)
	(percent)					(percent)				
None (career plans firm before YSP)	11	9	3	11	10	*	13	5	9	6
None (plans remain uncertain)	7	8	12	3	7	3	0	0	2	1
Made no difference, no further information	12	15	24	7	13	16	24	25	22	20
Helped to focus choice of career plan[2]	8	3	3	11	6	19	12	10	18	16
Familiarized me with different SEM fields	9	8	2	11	8	12	28	21	12	19
Increased my interest in SEM[3]	29	42	33	33	35	24	19	21	24	22
Decreased my interest in SEM[4]	6	0	8	2	3	9	3	0	6	6
Other[5]	18	16	15	22	17	17	1	18	7	10

*Denotes a number less than .5 percent and greater than 0 percent.

SEM = science, engineering, and mathematics.

[1]Includes minority groups not shown in table.

[2]Plan may be SEM or not SEM.

[3]Reasons most often given: because I became aware of new opportunities or challenges in SEM field; gained confidence in my ability to do SEM work.

[4]Reasons most often given: I became aware of my limitations; realized I did not really like SEM.

[5]Included became more interested in computers, motivated respondents to study harder, more self-confidence.

NOTE: Percentages may not add to 100 due to rounding.

SOURCE: *Short-Term Impact Study of Young Scholars Program*, National Science Foundation, 1994..

with respect to specific choices and subfield selections. But from a broader perspective regarding potential entrants into SEM fields, YSP did not appear to have a significant impact.

- Although our sample is thin with respect to gender and minority subgroups of participants, we can tentatively conclude that the program has been especially encouraging or reinforcing to African American students and less likely to encourage or reinforce the decisions of females to select careers in SEM fields.

To conclude this chapter, we present a few vignettes summarizing the actual conversations with some participants. They should give the reader a feel for what the respondents told us about themselves and their plans and may throw light on some of the findings in these chapters.

Student #1 participated in YSP when he was in the 7th grade and plans to become a scientist or an engineer.

C.'s father is a physicist, and his mother has a degree in geology. The family is white. According to his mother, he has always been a good student; she became aware of his interest in SEM when he was in the sixth grade. His parents have helped with math and science homework and take him to a science center in their community several times a year.

BEST COPY AVAILABLE

Table 2-17
Perception of SEM professions

Perception	Junior high students (grades 7-9)					Senior high students (grades 10-12)				
	Female (N=836)	Male (N=659)	African American (N=495)	White (N=692)	Total[1] (N=1,495)	Female (N=908)	Male (N=760)	African American (N=132)	White (N=1,065)	Total[1] (N=1,668)
	(percent)					(percent)				
Perception of job prospects										
Very good	61	78	50	74	68	65	64	73	68	64
Field is very competitive[2]	3	0	0	3	2	8	14	18	15	11
Good opportunities for women and minorities	8	5	15	3	7	1	0	0	1	1
Not good	9	5	7	6	7	7	11	2	6	9
Other	1	0	1	1	1	12	5	0	8	8
Don't know/Depends	18	12	26	13	15	7	7	7	3	7
Perception of own fit into SEM professions										
Good fit	79	88	75	84	83	73	90	93	78	81
Not good fit	5	0	7	2	3	15	6	7	13	11
Don't know/ Can't decide	15	12	18	14	14	12	4	0	10	8

[1]Includes minority groups not shown in table.
[2]This is often followed by the statement, "but I would succeed."
NOTE: Percentage may not add to 100 due to rounding.
SOURCE: *Short-Term Impact Study of Young Scholars Program*, National Science Foundation, 1994.

C. commuted to the Massachusetts Institute of Technology daily for 2 weeks to attend the program at the Haystack Observatory. He liked the program, especially because the lectures he heard were given by "real scientists," although he felt that some of them were too advanced. He had further contact by E-mail with his mentor, an atmospheric scientist whose project dealt with solar cycles. He did not establish networks with other participants because his project was not a popular one, and therefore there was not much interest among the other students.

He found out about the project from his father, who brought home a pamphlet; his science teacher also encouraged him to apply.

He has just completed the 10th grade with a 3.6 average, and plans to go to a 4-year university and major in physics or in engineering. So far, he has taken math courses through pre-calculus and has completed three science courses. He feels that the YSP experience has led to better understanding in his science classes.

His career plans include obtaining a Ph.D. and working in private industry or government. He said that his interest in science was high before the YSP, increased through the YSP participation, and has continued to increase ever since. Other than the YSP experience, he attributes his interest in science to his father's profession.

He is very optimistic about his chosen field and believes he will fit in very well. "These professions are more ethical and give more satisfaction than many other professions. Scientists are always needed. Jobs are more stable." The YSP showed him that scientists are real people. In summary, he said that the YSP confirmed and increased his interest and urges NSF to continue this program and fund more programs.

Student #2 participated in YSP when she was in 8th grade and plans to become a nurse.

R.'s mother has a degree in business administration; her father also has a college degree but "has no involvement with the children," according to the mother. This is an African American family living in the Midwest. The mother thinks her daughter's interest developed in the ninth grade, and she believes that the YSP may have had something to do with it. They are giving the child "moral and financial support" to encourage this interest, and they take trips to science fairs and museums with her.

R. attended the GMI Engineering and Management Institute for 3 weeks. She found the program interesting, and especially enjoyed the field trips. She mentioned a helpful and encouraging relationship with one of the graduate students in the program, and she also met some of the participants again in other programs. She found it rather difficult to write the essay that was required for the application, and she also felt that the application to the program put too much emphasis on the GPA.

She has just completed the 11th grade and her GPA is 3.0. After graduation, she plans to go to college and become a nurse/midwife; she hopes to earn a B.A. and an M.A. degree. Before attending the YSP program, she had thought about chemical engineering, but she now feels that there were "things she didn't know" that helped her decide to go into nursing. She was also influenced by doing volunteer work in a hospital. She summed up the interview by saying that the impact of YSP on her future plans was minimal, but that she enjoyed it.

Student # 3 participated in YSP when he was in 9th grade and plans to become an engineer.

J.'s mother is a practical nurse, and his father works as a welder and also as a driver. This African American family lives in the Midwest. The mother thinks her son showed an interest in engineering during his first year in high school. When asked how the parents encouraged or supported him in pursuing his science and engineering interests, she mentioned that they always stressed the importance of further education and setting goals.

J. participated in 1991 in a 6-week program at Michigan State University; he had previously participated in two YSP summer programs. Although he found it "scary" to leave home for that length of time, he enjoyed being in a campus environment and being treated as an adult. He felt that the courses were much more interesting than his school work and mentioned that his mentor was always there when needed and encouraged followup meetings. He also reported building several very close friendships with other participants. His junior high school teacher had given him a pamphlet about YSP, and the teacher and his parents had urged him to apply. He thought the applications were really, really hard, and that some people could and did cheat on the problems.

J. has just completed the freshman year at Western Michigan University with a GPA of 3.0. He is majoring in chemical engineering. He took a college preparatory curriculum in high school and three math courses and one introductory science course in college and feels that the YSP gave him a much better understanding of math and science material. He received a scholarship from a private company and hopes to get a job with this firm after he graduates. He also expects the company to pay for his studies for a master's degree.

His interests have gone back and forth between math and science; as a result of the YSP experience he shifted from science to math, but at present he likes both. He feels that the YSP gave him a better feel for the engineering field and made him even more optimistic about the field, job prospects, and his suitability than he already was before the program, which he summed up as a great educational experience.

Student #4 participated in YSP when he was in 11th grade and plans a medical research career.

D.'s mother has a master's degree in nutrition and public health. She works as a nutritionist in a hospital. His father has a medical degree and teaches in a medical college. This Asian American family lives in the Northeast. The mother observed her son's interest in science when he was in the fourth grade. To support this interest, the parents encouraged him to

participate in "extra" science programs and took him to science museums.

D. had been enrolled in a 6-week YSP program dealing with research on superconductivity (no further details available). He spoke very enthusiastically about the program, where he "really learned to do a research project." He met with his professor on a daily basis and still corresponds with other students from the program who are now his best friends. A friend of his mother told him about the program, and his mother encouraged him to apply. Subsequently, in 1993, he spent 8 weeks in San Francisco in the hospital of the UC San Francisco Medical School. He considers this a comparable experience to YSP.

He has just completed his junior year at Harvard, and he reports a double major in history and science. During the summer of 1994, he is working for a medical research company and also studies radiology at a hospital.

He described a very specific career plan, which consists of obtaining a medical degree and then going into chemical research to study liver regeneration. He explained that his interest has always been in the field of medicine, but that the YSP caused him to become interested in clinical research. He thinks he will fit into this field "like a hand in a glove," and that job prospects are excellent. The YSP had a major impact on his career decisions because it familiarized him with research.

Student #5 participated in YSP when she was in 11th grade and plans to become an orthodontist in private practice.

S.'s mother is an elementary school teacher, and her father is a cook. This is an African American family. According to the mother, her daughter did not seem very interested in science until the year before she participated in YSP, but now she is very interested. When asked if the parents had encouraged or supported this interest, the mother stated that "whatever she chooses to do, we give constant encouragement."

S. attended a program at the University of Buffalo that lasted 8 weeks and, in her words, "involved lab experiments, research, and presentations." What she liked best about it was doing and interpreting research. She felt the program was more advanced than the coursework she had taken, involved more hands-on activities, and was staffed by very knowledgeable instructors. While in the program, she did not establish significant relationships with her mentor, instructors, or other participants. She found out about the program through a notice posted in the high school counselor's office, and her mother, her chemistry teacher, and her English teacher had encouraged her to apply.

At the time we talked with her, she was a junior at the Rochester Institute of Technology, majoring in chemistry/pre-med studies. After graduation, she wants to go to dental school and become an orthodontist in private practice. The courses she took in the 12th grade and during the first 2 years of college included advanced calculus and quantitative analysis as well as advanced science courses; she said that these were standard for her major. She credited the YSP with giving her more confidence and a better understanding for this material.

She describes her career plan as very firm. She also reports that she was very interested in science prior to the YSP; her interest became stronger after participation in the program, and is even stronger now. The YSP helped her choose the field she wants to study; she was further influenced by a subsequent "science technology enrichment program" at the University of Buffalo. She sees herself fitting well into her chosen field, where there will be a lot of job opportunity, and feels that the YSP gave her the confidence "that I could do it."

Student #6 participated in YSP when she was in 10th grade and plans to become a math teacher.

T.'s mother gave us very little information about herself and her family; she merely indicated that she had been good in math when she went to school (got A's), that she is a single parent, and that her daughter has been interested in math from the time she went to high school. This white family lives in a small southern community.

T. herself was less articulate and less worldly than many of the other high school students with whom we had conversed. When asked to describe the program, she said that they "worked on the Macintosh" with a text called CHAOS and took field trips to visit Virginia Tech to see what campus life was like. She loved the experience, stressing how different it was from her high school where there is no access to computers to speak of ("we have so few IBMs"). She enjoyed the program very much, and mentioned that several graduate students have kept in touch with her progress.

She had learned about the program through her high school guidance counselor, who had encouraged her to apply. Her high school program included only required math and science courses; participating in YSP helped her "a lot."

After graduating from high school, she started college then stayed out for one semester and worked. At the time of the interview, she was back in college as a freshman with a math major. After graduation, she wants to take a master's program in math and then become a math teacher "from the 8th grade down. I do not want high school - the way those teachers are treated is awful."

She has always been interested in math, and the YSP experience strengthened this interest and it continues to be strong. But the YSP didn't really make a difference in her career plans, since she had always known what she wanted to do. She feels that she would fit well into the field because she loves children; she does not know anything about job prospects. She summed up her feelings about the impact of YSP on her future plans by saying, "Not really much for my future, but I am so grateful to have gone."

CHAPTER 3. CONVERSATIONS WITH NONPARTICIPANTS

Introduction

A sample of 84 applicants to the Young Scholars Program who were identified as nonparticipants was chosen to be interviewed as part of this study of the program. As we discovered in our initial conversations with them, 14 of these students had been classified incorrectly and had, in fact, participated in YSP during 1991. Therefore, the final sample of applicants to the YSP who had not participated was 70.

Informal telephone conversations with the nonparticipants centered around the following topics:

- Reasons for nonparticipation in the program;
- Participation in any similar types of programs;
- Current status of nonparticipants;
- College major (planned or actual) and plans for post-college education; and
- Career plans.

Data from the 70 nonparticipants were weighted to reflect the actual distribution of subgroups in the total population of applicants. This chapter begins with a description of the demographics of the nonparticipants. The remainder of the chapter presents the findings for the nonparticipants, and, when applicable, compares them to the findings for participants on the outcome indicators, namely choice of college major and career plans. Results are presented for the entire sample, and separately for students who were in junior high school (grades 7-9) and for those who were in high school (grades 10-12) at time they applied to the program. In addition, results are broken down by gender. However, because of the small sample size, the nonparticipant data were not examined according to ethnicity.

Characteristics of Nonparticipants

In general, there is little difference between the participants and nonparticipants in terms of grade level, gender, and minority status (see Table 1-1). Of nonparticipants, females made up 56 percent of the total group--59 percent of the junior high students and 53 percent of senior high students. Also, 16 percent of nonparticipants were African American, while 23 percent were from other minorities. More students from other minority groups were in senior high school (32 percent) than in junior high school (15 percent). At both grade levels, about half of all nonparticipants (56 percent) were white.

Reasons for Nonparticipation in the YSP Program

Students were asked why they had not participated in the YSP after applying in 1991. More than half (63 percent) of all nonparticipants reported that they had not been accepted into the program (Table 3-1). About one-quarter (27 percent) indicated that their acceptance status was unclear; either they had not heard if they had been accepted, or they did not know or remember this information at the time of the interview. Ten percent reported that they had been accepted but had made alternate choices, such as working or staying at home.

It is interesting to note that no junior high students reported that they had been accepted to the YSP but had chosen not to attend. Of the senior high students, however, 16 percent indicated that they had been accepted but chose not to attend. This may reflect the fact that students in senior high also have the opportunity for employment during the summer, while junior high students are generally too young to get jobs. They therefore have fewer alternatives to consider when faced with the chance to go to a program like the YSP.

Table 3-1
Percentage of nonparticipants indicating their reasons for not attending the YSP, by gender

Reason	All non-participants (N=5,499)	Junior high students (grades 7-9)			Senior high students (grades 10-12)		
		Female (N=1,569)	Male (N=1,046)	Total (N=2,615)	Female (N=1,518)	Male (N=1,366)	Total (N=2,884)
Not accepted	63	53	90	68	50	67	58
Accepted, chose not to attend	10	0	0	0	25	6	16
Acceptance status unclear	27	47	10	32	25	28	26

NOTE: Percentages may not add to 100 due to rounding.
SOURCE: *Short-Term Impact Study of Young Scholars Program*, National Science Foundation, 1994.

Table 3-2
Percentage of students indicating that they had participated in a similar type of program, by gender

Participation	All non-participants (N=5,510)	Junior high students (grades 7-9)			Senior high students (grades 10-12)		
		Female (N=1,674)	Male (N=1,255)	Total (N=2,929)	Female (N=1,442)	Male (N=1,138)	Total (N=2,580)
Yes	35	37	33	36	32	40	35
No	65	63	67	64	68	60	65

SOURCE: *Short-Term Impact Study of Young Scholars Program*, National Science Foundation, 1994.

Participation in Similar Types of Programs

Students who apply to programs like the YSP tend to attend academic enrichment programs during the summer. In fact, 30 percent of the 1991 participants in the YSP said that they had also attended other programs either before or after the 1991 YSP experience. Thirty-five percent of nonparticipants also reported that they had attended other programs (Table 3-2). There were no differences on this variable between the two age groups or between males and females.

Many of the alternative programs described by respondents were sponsored by colleges or universities. Others mentioned were state-sponsored programs, such as Missouri Scholars, North Carolina Governor's Scholars, and the Texas Prep program. (Apparently, students can attend the Texas Prep program as an NSF Young Scholar or through an alternative avenue.)

Current Status of Nonparticipants

As described in Chapter 2, students who were in junior high school in 1991 when they applied to the YSP were either still in high school or about to enter college at the time of the interview. Those who were in high school at the time of application had completed their sophomore or junior year of college. As with the participants, our conversations with nonparticipants addressed their plans for further education, choice of college major, and, where applicable, field of graduate study and career plans.

Further Education

Young people who apply to the YSP are academically motivated students. The majority of junior high school students who applied but either were not admitted or chose not participate in the YSP indicated that they intended to go to college (94 percent). Only 3 percent reported that they would go to work, and 3 percent were

not sure of their plans at the time of the interview.

All of the older students interviewed were attending college. When asked whether they had plans for after college, nearly three-quarters (67 percent) indicated that they planned to go to graduate school (Table 3-3). Women were somewhat more likely than men to express graduate school intentions (70 versus 56). Interestingly, this is the reverse of what was found in the sample of participants, where men were slightly more likely to express these intentions than women.

College Major. As discussed in Chapter 2, in assessing the impact of the YSP as a pipeline for students entering SEM fields, choice of college major is an important indicator. Table 3-4 presents the anticipated and actual college majors of students who applied but did not participate in the YSP. In order to assess the degree to which these students choose SEM areas of study and to compare them with those who did participate in the YSP, we have collapsed major fields into three broad categories: majors in the fields of science, engineering, and mathematics, majors in non-SEM areas, and majors in the health professions.

Exactly half of the nonparticipants who were still in high school indicated that they anticipated majoring in some SEM area of study. Among those already in college, nearly three-quarters (72 percent) reported that they were majoring in an SEM area. In both age groups, males outnumbered females in choosing majors in SEM areas. However, an unexpected finding was that the percentage of females nearly doubled between those intending to major in SEM fields and those who are actually majoring in them (34 to 65 percent).

Table 3-3
Percentage of nonparticipants indicating their post-college plans, by gender

Post-college plans	Senior high students (grades 10-12)		
	Female (N=1,518)	Male (N=1,366)	Total (N=2,884)
Graduate school	70	56	67
Work	20	28	25
Don't know	10	16	8
Graduate school field of study	**Female (N=1,063)**	**Male (N=759)**	**Total (N=1,822)**
SEM	21	50	34
Non-SEM	29	30	29
Health	50	20	37
Intended employment	**Female (N=304)**	**Male (N=379)**	**Total (N=683)**
Computers	0	20	33
Engineering	0	60	11
Non-SEM	50	20	33
Health	50	0	22

SEM = science, engineering, and mathematics.

NOTE: Percentages may not add to 100 due to rounding.

SOURCE: *Short-Term Impact Study of Young Scholars Program*, National Science Foundation, 1994.

Table 3-4
Percentage of nonparticipants indicating their anticipated and actual college majors, by gender

Anticipated major	Junior high (grades 7-9)			Senior high (grades 10-12)		
	Female (N=1,569)	Male (N=1,360)	Total (N=2,929)	Female (N=1,518)	Male (N=1,366)	Total (N=2,884)
SEM	34	70	50	65	78	72
Non-SEM	33	23	29	15	11	13
Health	33	8	21	20	6	13
Don't know	0	0	0	0	6	3

SEM = science, engineering, and mathematics.

NOTE: Percentages may not add to 100 due to rounding.

SOURCE: *Short-Term Impact Study of Young Scholars Program*, National Science Foundation, 1994.

When these data are compared with those of students who participated in the YSP program, they are surprisingly similar. In fact, there are virtually no differences between the two groups for the younger students still in high school, and only slight variations between the two groups for those in college (see Table 2-9). Again, the tendency for more females to actually major in SEM areas compared to those who expressed such intentions at a younger age also was evident from the participant data.

While one might initially find this absence of differences in choice of college major unexpected, they are actually not surprising. Students who apply to the YSP are motivated, academically oriented young people. In addition, they have demonstrated an interest in science, engineering, or math by virtue of the fact that they are aware of, and have applied to, a program such as the YSP. Of those applicants who either were not admitted or chose not to attend, many found alternate routes to pursuing their interests through other kinds of programs.

Post-College Education. A large percentage (67 percent) of nonparticipants indicated that they planned to go to graduate school after college (Table 3-3). Among these students, the most frequently mentioned areas of study were in the health professions (37 percent). This is similar to those participants who expressed intentions of going to graduate school, of whom 29 percent indicated health-related areas. Approximately one-third of the nonparticipants expressed an interest in pursuing graduate study in an SEM field, with slightly more participants (43 percent) expressing such desires.

Career Plans

Twenty-five percent of the nonparticipants who are already in college reported that they intended to work upon graduation (Table 3-3). Almost half of these students (44 percent) named employment in the fields of engineering or computing. In fact, 60 percent of the males in this population named engineering as their choice of employment. This makes sense, since students who pursue undergraduate study in engineering are well prepared to enter the work force without further schooling. This is true for students with expertise in computing as well. Thus, while these students may not feel compelled to continue their schooling beyond college, their interest in SEM and SEM-related areas, such as certain aspects of computer technology, remains evident.

In general, the career plans of the nonparticipants mirror those of the participants, which is not surprising in light of the other findings. Twenty-nine percent of junior high students (compared to 35 percent of the participant group) and 42 percent of senior high students (compared to 41 percent of the participant group) plan to enter SEM careers (Table 3-5). In this latter group, the majority of males (73 percent) said that they intended to pursue careers in SEM areas.

Career plans in the health professions are stronger for this group than for the participants,

particularly for the older group of students. Of the nonparticipants now in college, 37 percent (compared to 21 percent of the participant group) mentioned entering careers in health. For females, interest in health careers is especially strong, with 60 percent reporting that they intend to enter health-related professions. These data probably reflect the fact that numerous occupations that are typically considered health-related, such as nursing, laboratory technology, and physical therapy, have traditionally been undertaken by women. Only 24 percent of female participants named health-related fields as a career choice.

Table 3-5
Percentage of nonparticipants indicating their career plans, by gender

Anticipated career	Junior high (grades 7-9)			Senior high (grades 10-12)		
	Female (N=1,674)	Male (N=1,569)	Total (N=3,243)	Female (N=1,518)	Male (N=1,366)	Total (N=2,884)
SEM	6	53	29	15	73	42
Non-SEM	44	20	32	15	11	13
Health	25	13	19	60	11	37
Don't know	25	13	19	10	6	8

SEM = science, engineering, and mathematics.

NOTE: Percentages may not add to 100 due to rounding.

SOURCE: *Short-Term Impact Study of Young Scholars Program*, National Science Foundation, 1994.

CHAPTER 4: CONVERSATIONS WITH PARENTS

Introduction

Conversations were conducted with 52 parents whose sons or daughters had participated in the YSP program. Depending on availability, these conversations took place with either parent, although most involved the mother. In a number of cases, there was no father living or present in the household; in two cases, the student lived with a grandparent or other relative.

Table 4-1 summarizes the available information about the gender, ethnicity, and 1991 grade grouping (7-9 or 10-12) of these students. It also shows the occupation and education of father and mother as reported by these students on the YSP application in 1991.[13]

As discussed in the chapter on students, there was considerable variation in the definition of science in this group: in particular, many students think of interest in the health fields and health professions as interest in science, whereas NSF (in its classification of fields of study) does not include the health fields under the heading of science. Similarly, many parents also felt that interest in medicine or nursing was evidence of a scientific orientation, although those who were engineers or scientists usually adopted a narrower definition. This issue needs to be kept in mind when evaluating the parents' statements about the program's effectiveness in stimulating their children's interest in science and scientific careers.

Table 4-1
Characteristics of all YSP participants in Westat study and of those whose parents were interviewed

Characteristic	All participants in Westat study (N=199)		Participants whose parents were interviewed (N=52)	
	Number	Percent	Number	Percent
Grade level at application				
7-9	95	52	33	64
10-12	104	48	19	36
Student's gender				
Female	115	58	28	55
Male	84	42	23	45
Student's ethnicity				
Asian/Pacific Islander	28	14	8	15
African American (non-Hispanic)	39	20	12	23
Hispanic	17	8	4	8
White (non-Hispanic)	113	57	26	50
Native American	2	1	2	4

SOURCE: *Short-Term Impact Study of Young Scholars Program*, National Science Foundation, 1994.

[13] It should be pointed out that the data we have for parental education was furnished by students at the time they applied to a YSP project. The information reported by students about their parents' education is often inaccurate (see *Quality of the Responses of Eighth-Grade Students in NELS:88*, Technical Report, National Center for Education Statistics, September 1991).

Since these conversations were highly idiosyncratic and varied widely depending on the parent's educational and professional background and choice of topics, we did not attempt a formal quantitative analysis. Instead, we present a largely qualitative and anecdotal narrative of the information yielded by these conversations.

It should also be pointed out that the extent to which the parents were able to furnish extensive or correct information about their children's reaction to the YSP or career interests varied a great deal; a few parents indicated that they did not know how their children had reacted to the YSP or simply stated that since they had had no problem getting the child to attend every day, the program was probably interesting to the student. In a few cases, when we checked the parents' answers against the information that the children themselves had supplied when they were interviewed, it turned out that the child expressed definite career interests or plans of which the parent was unaware.

Topics Covered in Conversations

The conversations were conducted by Westat staff members using a discussion guide that covered four areas:

- **Impact of YSP.** In this segment of the conversation, the interviewer sought to obtain the parent's evaluation of the YSP experience at the time of the child's participation. Additional topics dealt with the influence of participation on the child's subsequent activities, interest in SEM, and on the attitudes or activities of other family members.
- **Perception of child's interest in SEM.** Here, the interviewer sought to learn about specific SEM areas in which the child is interested and the strength of this interest, the time when the child first displayed this interest, the extent to which various individuals or experiences may have played a part, and the parent's awareness of the child's career interests.
- **The parents' own interest and professional involvement in SEM.** This segment of the conversation sought information about the parents' own interest and professional involvement in SEM. The conversation also probed the extent to which the parents encouraged or supported the child's interest in SEM and involvement in YSP.
- **Suggestions for improving YSP.** Finally, the parent was asked for suggestion to strengthen or improve the program.

Findings

Program Impact on Participating Child

The parents' comments about program impacts were uniformly favorable; almost every parent felt that his/her child had greatly benefited from participating. Not surprisingly, the comments made by parents of younger children (those in grades 7, 8, and 9 at the time of participation) were often different from those offered by parents whose children were in senior high school (all of whom were in grades 10 or 11).

Impact on Younger Children. Many parents of younger children stressed the extent to which their children became more motivated to do well in school. Several parents mentioned that their child became acquainted with other students who were high achievers and had strong academic motivation. Some felt that the child's self-esteem was raised considerably, perhaps by the mere fact of acceptance into a prestigious, competitive program. Others spoke about children gaining more insight into their goals and talents, although this did not necessarily lead to preference for SEM subjects. The following comments were typical:

> *A tremendous experience - built self-esteem and confidence* (mother of 8th grade white male student).

(Influenced) motivation to do well, self-esteem, academic achievement; learned what it means to give your time to advance self that does not involve getting paid... This program really turned her life around. Before, she had peer pressure to do poorly in school. This put her in touch with other academically talented black students (mother of 7th grade African American female student).

She met lots of other kids and started her looking at college (mother of 7th grade white female student).

Many parents also observed that the program increased their children's interest in SEM and led them to select more advanced or difficult courses. In a few cases, however, the program made them aware of difficulties or, to them, unattractive aspects of SEM:

She sought more advanced studies in math (mother of 8th grade white female student).

Took all college prep courses. Challenged herself (mother of 8th grade Hispanic female student).

Helped develop a real love for math and science (mother of 9th grade African American female student).

The science part was very interesting and held his interest in science. He signed up for science and math, especially math (mother of 8th grade white male student).

She said it was fairly challenging and some of it was over her head...she also said she was overwhelmed with the math (probability)...she had thought of a career in zoology. She was very young and impressionable when she went into YSP and I think some of the math scared her, she lost some confidence (mother of 9th grade white female student).

Gave her confidence in tackling difficult things. Having satisfactorily completed the task, she knew she could succeed at other things. Prior to this she wanted to go into marine science, but all numbers and data made her decide not to....Now she wants to major in history (mother of 9th grade white female student).

Impact on Older Students. We held conversations with 19 parents of students who were in senior high school at the time they participated in the YSP in 1991. All of them were in college when their parent was interviewed in 1994.

Perhaps because these young people had left home and for the most part had made definite career choices, their parents' recollection of the YSP experience were less vivid and salient; they provided fewer comments about the impact of the YSP than had the parents of younger children.

In 1994, all of these older participants were in college and 11 of them had selected a major in the sciences, math, or engineering; one was undecided, but likely to choose a scientific field. Parents of those who majored in these SEM fields were less likely to stress the general educational benefits of the program and spoke more often about ways in which the program supported their child's long-standing interest in SEM. But without exception, parents felt that the program had been very worthwhile and beneficial. Of the eight students who had not elected to major in one of the SEM fields, five were studying for one of the health professions and their parents saw a clear connection between YSP and their child's subsequent academic careers. Even the mother whose daughter was a business major felt that her daughter's exposure to computers had stimulated her interest in math and had therefore influenced her choice of a business major.

Impact on Family Members

In a number of instances, younger siblings sought admission to YSP programs, perhaps because the participant praised the program and had benefited or because parents became aware of an opportunity they had not previously known about. Our data suggest that this was especially true of minority participants. Other parents simply reported that the participant's program experience led siblings to become more interested in math and science. A few mothers saw some impact on the parents' own interest and behavior.

> *Two younger children in 6th and 8th grades look forward to the time when they can go to such a program* (mother of 8th grade Hispanic female student).
>
> *Younger brother is currently in KEYS program* (same program as participant attended in 1991; mother of 7th grade Asian female student).
>
> *Her sister was enrolled in the same program* (mother of 9th grade African American female student).
>
> *Younger sister wants to apply to same program in the future* (mother of 10th grade Asian female student).
>
> *Influenced his brother to become interested in the computer* (mother of 7th grade white male).
>
> *Influenced mother to begin recycling plastic containers through Walmart* (mother of 9th grade white male student).
>
> *Mother ended up coaching local math teams at the high school after son came back from YSP* (mother of 9th grade Asian male student).
>
> *Father's interest in science has heightened* (mother of 7th grade white male student).

Perception of Child's Interest in SEM

One of the most interesting findings yielded by these conversations was the early interest in math and/or science that the majority of these parents had observed in their offspring; a very high proportion reported that they saw evidence while their children were in elementary school or even earlier. The findings were especially striking for the 19 high school participants who were college students in 1994 and had chosen a major: of the 11 students who had chosen one of the SEM fields, 8 had displayed an early interest, and 2 had done so in junior high school, according to their parents. The one student who was said to have decided late (after participating in the YSP) is majoring in biology and plans to go to medical school. In only two other instances did parents indicate that their children first became interested in SEM after they had attended the Young Scholars Program: one of these students is majoring in a health field, and the other elected to major in business.

Similar findings emerged from the conversations with the 33 parents whose children were in junior high school when they attended the YSP program. With one exception, these students were either still in high school in 1994 or had just graduated and were about to enter college in the fall. According to their parents, 7 of these students were undecided about their choice of major, 10 had expressed a definite choice for one of the SEM fields, and 8 had indicated that they would select a major in a medical field; the remaining 8 had chosen other fields.[14] Six of the 10 parents whose children are planning to major in one of the SEM fields reported that children had shown an early interest in math and/or science; 3 became aware of the interest when their children were in school; and only 1 parent felt that the YSP had first stimulated this interest. Conversely, 6 of the 8 parents whose children had elected to major in

[14] It should again be stressed that for many students and parents there is no clear-cut line between SEM and health fields. In fact, the distinction is really an artificial one, especially for students who plan to go to medical school. Thus, several students and parents indicated that the choice of a biology major was made with an eye on future entry into medical school. Following the NSF classification system, we have classified these students as majoring in one of the SEM fields, whereas those who indicated that they planned to enter an undergraduate pre-med program are classified as being in a health professions field.

one of the health fields pointed to the YSP as the major source of the child's interest in science or scientific research.

Parental Background and Professional Involvement in SEM

The parents of students who were selected for participation in YSP programs are better educated and more often work in professional and managerial occupations than a cross-section of Americans in the same age groups. This phenomenon is understandable: we know from other studies that although students can excel academically regardless of their family background, those who do so come disproportionately from families that have the educational background and financial resources to support and enhance their children's educational pursuits. They also tend to live in communities where schools offer more advanced and challenging courses.

We examined the information on parental background to assess the importance of this factor on a child's career interests and occupational choice. How much do parents actually influence these interests and choices? In what ways do parents encourage and support their child's math and science education? In what ways did they support the child's involvement in YSP? These questions were explored in our conversations with the participants themselves; here we present the parents' perspectives.

As expected, in families where either parent is a scientist or engineer, children are exposed to talk about science or math at an early age. However, given the very small number of cases in this study and the very small number of scientists and engineers in this group of 52 parents (5 of the fathers and 3 of the mothers reported these occupations), we cannot say much about the extent to which these role models affected their children. But in many more families of YSP participants, we obtained evidence of considerable interest and involvement in SEM. For example, one father, a lawyer, had majored in physics. Another father who is an actuary had obtained a master's degree in geochemistry. Interest in math and science runs high in these families. This is especially true when the mother is a teacher (regardless of the grade or subject taught) or works in the health field, usually as a nurse. But many of the fathers also were clearly interested in science, engineering, and math:

> *Husband is an office and billing service manager. He has recreational interests in science* (mother of 11th grade white male student).
>
> *Father is general building contractor. He gets involved in design and engineering of buildings* (mother of 10th grade white male student).
>
> *I am a draftsman, have degree in construction. Am very interested in engineering: mechanical, structural, civil* (father of 8th grade male student, ethnicity not known).
>
> *Father is a mechanic and farmer, very interested in science and engineering* (mother of 8th grade white female student).
>
> *Father is an air traffic controller. He is interested in astronomy and environmental studies* (mother of 8th grade white female student).

The conversations suggest that the majority of these parents have a very positive attitude toward math and science. Many of them volunteered that they liked math or science and had done well in these subjects in school; none of them expressed dislike or fear of these subjects.

Parental Encouragement and Support for Child's Involvement in SEM

Most parents indicated specific ways in which they supported their children's interests in SEM and had encouraged the application to YSP. But many of them also pointed out that they would support the child in whatever he or she wanted to do and did not try to exert influence over specific academic or career decisions. Minority parents often stated that they were primarily interested in

encouraging their children to get as much education as they could and to take their studies seriously, rather than encouraging them to go into a specific field. Those who mentioned a preference for their child's future career often mentioned one of the health fields.

> *We show that we respect what she's interested in. We don't believe in pushing her, though. We have always told her that whatever she wants to do is fine* (mother of 8th grade Asian female student).

> *I told her that math is essential in any field she wants to follow. Told her how important it is to study, study, study* (mother of 11th grade Hispanic female student).

> *Whatever she chooses to do, we give constant encouragement* (mother of 11th grade African American female student).

Those who pointed to specific things they had done to encourage their child's interest in SEM pointed to museum visits during the school year and during vacations. This was by far the most frequently mentioned activity. But there were many others: parents sought out special school programs, bought computers, bought books and subscribed to magazines (for example, *Discover* and *National Geographic*), hired tutors, encouraged their children to become tutors, and took their children to career fairs and science fairs. Surprisingly, only a few mentioned helping their children with science projects or monitoring or helping with homework, perhaps because many of these talented students did not need help.

Parents' Influence or Support for YSP Participation

The majority of these parents had actively encouraged their child to apply to the program; many, especially those who were teachers, were their children's first source of information about the program and obtained the application forms for them (several said the forms were not always easy to get). A few had helped their children to complete the application or had reviewed the essay that applicants were required to write. Some also mentioned writing commitment letters, which were apparently required by some programs. But by far, the most frequent statements dealt with transportation: parents had driven the student, often on a daily basis, so he or she could attend. In other cases, parents mentioned the purchase of plane tickets and the payment of tuition or other expenses as their way of supporting the child's participation. Given the earlier finding that students were overwhelmingly enthusiastic about participation and were eager to attend the program for as long as it was offered, parents evidently saw no other role for themselves except to enable their child to get to the program site and make attendance financially possible.

Conclusion

It would be presumptuous to evaluate the impact of the YSP on its participants based on the anecdotal data collected in these telephone conversations. There are indicators that some participants expect to follow in their parents' professional footsteps, especially in the medical field. With respect to SEM, our data suggest the same pattern, perhaps less because of parents' trying to influence their children's choices (which most of these well-educated parents feel is unacceptable) but because they provide a nurturing atmosphere at home and through recreational and educational initiatives for their children. However, it is also clear that most of the parents of future SEM career candidates are not highly educated professionals, and that the children themselves show a very early interest in SEM. We do not know how much of this is due to environmental and parental stimuli as opposed to genetic predispositions, but it should be noted that this early interest was reported by many of the less-educated and nonprofessional parents in our small sample.

What can we conclude from parental answers about the contribution the YSP has made to the lives of participants and their future careers? Clearly, the parents feel that it was an excellent experience that encouraged and reinforced the

interests of students who were predisposed toward SEM. This is, of course, not surprising given the strong selection emphasis on students who were high achievers in these subjects in junior and senior high school. For students who were not predisposed to enter SEM fields, the YSP experience did not create a new commitment. But it did provide exposure, and, especially for minority students, opportunity and motivation to identify with academic pursuits, although not necessarily in the SEM field. This is an important contribution to these children's future. As we have concluded in Chapter 2, if one takes the broader view expressed by the participants and parents who include the health fields in the science category, the YSP has undoubtedly encouraged and reinforced interest in science in the opinions of the parents.

CHAPTER 5. CONCLUSIONS

The purpose of this study was to take a look at the Young Scholars Program from the point of view of its impact on participants and to examine the extent to which the program excites them about SEM fields and encourages them to pursue careers in SEM areas. The results of our conversations leave us with a mixed picture of the program's impact.

First, from the point of view of whether or not the Young Scholars experience is a positive one, the answer is clearly a resounding "Yes!" Both participants and their parents had high praise for the program, evidenced excitement about their experiences, and felt the learning opportunities were extremely valuable. Parents of minority students, and some of the minority students themselves, made some particularly strong and heartfelt statements about the value of the program and its general impact on attitudes toward learning and expectations for continued education.

Second, from the point of view of whether or not participants actually pursue careers in SEM-related fields, the findings are also positive, but the impact of program participation on that choice is less clear. Our data show that SEM majors are elected by somewhat greater than 60 percent of the program participants and that a slightly smaller number (40 percent) plan to enter SEM-related careers. While this choice of majors is almost three times that occurring in the overall population, it is also clear that the program participants are a very atypical group and from the beginning seek out the Young Scholars activities because of their interest in the SEM fields. Thus, while we can conclude that participation in a Young Scholars Program probably reinforces the interest that many talented young people have in pursuing an SEM-related career, stronger impact statements are not warranted.

Examination of data on selection of majors and career choice from students who applied to, but did not attend, the Young Scholars Program provides additional information to support this conclusion. These students report patterns of major choice and career selection that are almost identical to that of the program participants. In fact, in some cases, the continued interest of the nonparticipants in SEM-related activities appears to be somewhat higher than that of participants. Again, however, it must be acknowledged that these nonparticipants are also a special group. Like the participants, they have an active interest in science, engineering, mathematics, and technology and are strong students. Further, around a third of them have participated in special programs that share many of the features of the Young Scholars Program, without carrying that label.

The findings regarding African Americans and females are cause both for optimism and concern. The program clearly seems to have an especially reinforcing impact on African Americans. In contrast, while women are equally positive about the program and derive important networking opportunities from participation, they differ substantially in the ultimate selection of majors and careers in SEM-related areas. The limitations of our sample and the design of our protocols does not allow us to do more than touch the surface of both of these important findings. These are, however, areas that NSF might wish to look at more closely.

Taken together these findings suggest that the Young Scholars Program can be seen as an important contribution to the mosaic of experiences that lead bright, motivated students to pursue advanced degrees and select challenging professional roles. An impressive number do seek careers in SEM-related fields. And, those who want to make sure that the medical field retains its share of talented young people will certainly find the career choices of many of the program participants to be a very positive outcome. Perhaps it is unrealistic to expect participation to have dramatic effects on this select group of students, as both those who participate and those who satisfy their interests in other ways already begin with a very proactive stance toward learning in general and science in particular. Contributing to their continued

excitement as learners is an end of considerable merit.

In reviewing these results and attempting to understand their meaning, it is important to repeat some cautions mentioned in the sampling discussion provided at the beginning of this report. First, our examination of program impact looked across the program generally, sampling students from a wide diversity of programs, some which may well be stronger than others. Before drawing conclusions regarding the impact of any program on the SEM pipeline, it would be important to look more specifically at individual programs to see whether or not there are any systematic relationships between the structure of the programs and the impacts that are found. Second, our analyses looked generally across participants, with a limited examination of program impact on the subgroups of females and African Americans. We cannot say what the findings would be if we had been able to disaggregate the data in a more extensive way.

TECHNICAL APPENDIX

SAMPLING AND DATA COLLECTION DESIGN, PROCEDURE, AND OUTCOMES

TECHNICAL APPENDIX

SAMPLING AND DATA COLLECTION DESIGN, PROCEDURE, AND OUTCOMES

Sample Design

The sample design was structured to obtain interviews with approximately 160 participants in the 1991 YSP program and with approximately half as many comparison students who applied to but did not participate in the program. The participant group included systematic representation both of participants who had responded to the second (1993) COSMOS followup (for whom both initial and current interest in science careers were known) and of those who had not responded (whose omission from the study could easily skew the findings and lead to mistaken conclusions about the post-program experiences of YSP participants).

The focal issue to be examined in this study is the impact of the YSP program on the science, engineering, and mathematics (SEM) career pipeline. Among participants for whom career interest in science and mathematics had been ascertained both at the time of their application to YSP and at the time of the second COSMOS followup, we wanted to ensure adequate representation in the data base of four analytically interesting groups, which potentially indicate/reflect different pipeline-related impacts:*

1. Stayers. Students who expressed a strong interest in science careers before YSP and who continued to express such an interest in the latest COSMOS followup.

2. Leavers. Students who expressed a strong interest in science careers before YSP but whose interest appeared to have waned by the time of the latest COSMOS followup.

3. Converts. Students who did not express a strong interest in science careers before YSP but who subsequently indicated such an interest in the latest COSMOS followup.

4. Nonconverts. Students who did not express a strong interest in science careers before YSP and who still did not indicate such an interest in the latest COSMOS followup.

To obtain modest representation in all four of these categories, it was decided to allocate two-thirds of the total target participant sample (i.e., about 100 "slots") to participants with followup data, who could be sorted into these groups. Each of the four pipeline-related subgroups was represented equally in the target sample. The remaining participant slots (about 50 in number) were allocated to the larger group of participants for whom followup data were not available.

The target sample was further subdivided by student age/grade, with junior high students (grades 7-9) and senior high students (grades 10-12) being equally represented in each sampling category. The resulting targets are shown in Table 1.

---

*The classification is based on answers to the following question, which was asked both in the applicant questionnaire and in the latest followup: "How likely is it that you will become a scientist, engineer or mathematician in the future?" The response choices were: "a very good chance (better than 50 percent)," "even chance (50 percent)," and "not a very good chance (less than 50 percent)." Students who gave the first answer (a very good chance) were classified as having a strong interest in science careers. Those who gave one of the other answers or who failed to answer the question were classified as "other."

Table 1. Target number of YSP impact study interviews, by YSP student group and grade in school

Group	Student grade		
	Total	7-9	10-12
Total	236	118	118
Participants with followup data, by high school and followup likelihood of entering science careers (good versus other):*			
Total	104	52	52
Good (HS) - Good (FU)	26	13	13
Good (HS) - Other (FU)	26	13	13
Other (HS) - Good (FU)	26	13	13
Other (HS) - Other (FU)	26	13	13
Participants without followup data	52	26	26
All other applicants**	80	40	40

*The classification is based on answers to the following question, which was asked both in the applicant questionnaire and in the latest followup: "How likely is it that you will become a scientist, engineer or mathematician in the future?" The response choices were: "a very good chance (better than 50 percent)," "even chance (50 percent)," and "not a very good chance (less than 50 percent)." Students who gave the first answer (a very good chance) were classified as having a strong interest in science careers. Those who gave one of the other answers or who failed to answer the question were classified as "other."

**Applicants for whom there is no further information in COSMOS files beyond application. This group includes applicants who were not accepted, applicants who were accepted but did not participate, and participants for whom only application data are available.

It was decided to oversample initially to ensure that these rather small targets would actually be attained. We used an assumption that the final response rate might be as low as 50 percent. This is an unusually pessimistic assumption, which we made in this case for several reasons:

- Previous followup efforts with YSP participants have had response rates below this level;
- The locating information that was available for many of the sampled students would be several years out of date, especially for the unsuccessful applicants and the participants who had not responded to earlier followups;
- The time and resources available for tracking and interviewing students were restricted; and
- All of the interviewing was to occur during the summer, when students are often away from home and are inaccessible for telephone interviewing.

Based on these assumptions, initial sample sizes were set at twice the size of the targets shown in Table 1.

Sampling

Using 1991 YSP datafiles supplied by COSMOS, three sampling files were created:

1. Participants who responded to the second COSMOS followup study, subdivided by grade (junior high or senior high) and by pipeline category (the four career interest groups described above). The eight resulting groupings were sorted and listed by gender within ethnic group.

2. Participants who did not respond to the second COSMOS followup study, subdivided by grade and then sorted/listed by gender within ethnic group.

3. All other applicants (i.e., students in the applicant data base but not in either of the above groups), subdivided by grade and then sorted/listed by gender within ethnic group.

For each of the 12 resulting groups, a systematic random sample of the desired size was selected. Table 2 (junior high) and Table 3 (senior high) show the total number of students in the 1991 YSP program in each of these groups and the number sampled from each group. Table 4 provides totals that combine the junior high and senior high components.

The procedure for systematic random sampling within a given group was first to calculate a sampling interval (i), defined as the ratio of the number of students in the program to the number to be sampled, and then to select a random start number (s) between 1 and i. Beginning at the top of the listing for the group in question, the person in the sth position was selected, and every ith person thereafter was also selected. Since the listings had been ordered by gender within ethnic group, this procedure ensures a good representation of the ethnic diversity that actually exists in each group and, to a less precise extent, proportionate representation by gender, as well.

Data Collection

Once the sample was selected, a computerized receipt control (R/C) system was established to track the progress of the data collection for each sampled student. The R/C system included all of the variables that had been used to group and order students in the sample design, permitting us to track data collection progress group by group.

Table 2. Sample design and response rate for YSP impact study, students in grades 7-9

Student group	Number in YSP program	Number in sample	Number of respondents	Response rate[1]	Estimation weight[2]
Total	6,014	236	137	58%	-
Participants with followup data, by high school and followup likelihood of entering science careers (good versus other):[3]					
Total	754	104	66	63	-
Good (HS) - Good (FU)	307	26	14	54	21.9
Good (HS) - Other (FU)	130	26	16	62	8.1
Other (HS) - Good (FU)	111	26	19	73	5.9
Other (HS) - Other (FU)	206	26	17	65	12.1
Participants without followup data	973	52	30	58	32.4
All other applicants[4]	4,287	80	41	51	104.6

[1]Response rate = Number of respondents ÷ Number in sample.

[2]Estimation weight = Number in program ÷ Number of respondents.

[3]The classification is based on answers to the following question, which was asked both in the applicant questionnaire and in the latest followup: "How likely is it that you will become a scientist, engineer or mathematician in the future?" The response choices were: "a very good chance (better than 50 percent)," "even chance (50 percent)," and "not a very good chance (less than 50 percent)." Students who gave the first answer (a very good chance) were classified as having a strong interest in science careers. Those who gave one of the other answers or who failed to answer the question were classified as "other."

[4]Applicants for whom there is no further information in COSMOS files beyond application. This group includes applicants who were not accepted, applicants who were accepted but did not participate, and participants for whom only application data are available.

Table 3. Sample design and response rate for YSP impact study, students in grades 10-12

Student group	Number in YSP program	Number in sample	Number of respondents	Response rate[1]	Estimation weight[2]
Total	5,034	236	148	63%	-
Participants with followup data, by high school and followup likelihood of entering science careers (good versus other):[3]					
Total	828	104	68	65	-
Good (HS) - Good (FU)	523	26	19	73	27.5
Good (HS) - Other (FU)	128	26	14	54	9.1
Other (HS) - Good (FU)	53	26	17	65	3.1
Other (HS) - Other (FU)	124	26	18	69	6.9
Participants without followup data	866	52	36	69	24.1
All other applicants[4]	3,340	80	44	55	75.9

[1]Response rate = Number of respondents ÷ Number in sample.

[2]Estimation weight = Number in program ÷ Number of respondents.

[3]The classification is based on answers to the following question, which was asked both in the applicant questionnaire and in the latest followup: "How likely is it that you will become a scientist, engineer or mathematician in the future?" The response choices were: "a very good chance (better than 50 percent)," "even chance (50 percent)," and "not a very good chance (less than 50 percent)." Students who gave the first answer (a very good chance) were classified as having a strong interest in science careers. Those who gave one of the other answers or who failed to answer the question were classified as "other."

[4]Applicants for whom there is no further information in COSMOS files beyond application. This group includes applicants who were not accepted, applicants who were accepted but did not participate, and participants for whom only application data are available.

Throughout most of the data collection period, two groups of telephoners were involved. The first group concentrated on locating the sampled students, contacting them, and scheduling an appointment for an interview. The second group of more highly trained interviewers, who had received a detailed briefing on the purposes and intended content of the interview discussions, followed up on these initial contacts by calling respondents at the agreed-upon day and time to conduct the interview.

The data collection operation was structured to achieve the target number of interviews in each of the 12 sampling groups, within the time frame and budget constraints that applied to the project. The schedulers initially attempted to set up appointments with somewhat more than half of the sampled students in each sampling group, taking care to ensure balanced representation by ethnic group and by gender within each sampling group. Rescheduled appointments and contacts with additional students were

made, as necessary, to compensate for any problems that were encountered by the interviewers who followed up on the appointments. Toward the end of the data collection period, we faced a number of situations where interviews had been completed with nearly 50 percent (or more) of the sampled students in a particular group without exhausting the appointments that had already been made. At that point, we stopped attempting to contact any additional students in the group, and we did not reschedule any interviews that students could not keep at the appointed time. Howevér, wherever outstanding appointments remained, we did call to keep the appointment and conduct the interview, even if we had already reached or exceeded the initial target for the sampling group.

The data collection operation was more successful than we had anticipated. We exceeded the initial 50 percent response targets in all 12 sampling groups. Final response rates within sampling groups ranged from 51 percent to 73 percent (Tables 2 and 3), with an overall response rate of 60 percent (Table 4). With additional time or resources, a much higher response rate could have been achieved. Of the 472 initially sampled students, problems were encountered with only 59 students: 47 (10 percent) could not immediately be located; 9 others (2 percent) were located but were found to be out of the country or otherwise inaccessible during the interviewing period; and 3 (under 1 percent) were classified as initial refusals. No serious efforts were made to trace the initially unlocated students or to "convert" the initial refusals. The largest group of nonrespondents consisted of 123 students whom we did not interview, simply because data collection activities were closed out before we got to them.

Table 4. Sample design and response rate for YSP impact study, total students in grades 7-12

Student group	Number in YSP program	Number in sample	Number of respondents	Response rate[1]
Total	11,048	472	285	60%
Participants with followup data, by high school and followup likelihood of entering science careers (good versus other):[2]				
Total	1,582	208	134	64
Good (HS) - Good (FU)	830	52	33	63
Good (HS) - Other (FU)	258	52	30	58
Other (HS) - Good (FU)	164	52	36	69
Other (HS) - Other (FU)	330	52	35	67
Participants without followp data . .	1,839	104	66	63
All other applicants[3]	7,627	160	85	53

[1]Response rate = Number of respondents ÷ Number in sample.

[2]The classification is based on answers to the following question, which was asked both in the applicant questionnaire and in the latest followup: "How likely is it that you will become a scientist, engineer or mathematician in the future?" The response choices were: "a very good chance (better than 50 percent)," "even chance (50 percent)," and "not a very good chance (less than 50 percent)." Students who gave the first answer (a very good chance) were classified as having a strong interest in science careers. Those who gave one of the other answers or who failed to answer the question were classified as "other."

[3]Applicants for whom there is no further information in COSMOS files beyond application. This group includes applicants who were not accepted, applicants who were accepted but did not participate, and participants for whom only application data are available.

In retrospect, if the study had been more oriented to production of statistically precise quantitative estimates based on standardized questionnaire findings (rather than upon unstructured conversations dealing with broadly defined topic areas), it would have been preferable to have selected a smaller initial sample and to have pressed for a higher response rate. Even though we attempted to (and did) achieve a demographically well-balanced subgroup of respondents within each of the 12 sampling groups, we cannot be as confident about the accuracy and representativeness of findings based on a 60 percent response as we would with a response rate of 85-90 percent, which we now believe would have been feasible with this population.

Table 5 shows the race/ethnicity and gender distributions of the study respondents, by YSP participant status and grade level. These distributions are generally similar to the race/ethnicity and gender distributions for the total YSP program and for the selected samples of participants and nonparticipants. However, the numbers of respondents in several race/ethnicity categories are not large enough to justify separate analysis. Using 10 respondents as a minimum cutoff point, black (non-Hispanic), and white (non-Hispanic) are the only participant groups that are large enough for separate analysis at both grade levels; among nonparticipants, none of the race/ethnicity groups except white (non-Hispanic) have sufficient numbers of respondents for separate analysis at either grade level.

Table 5. Ethnicity and gender of YSP impact study respondents, by participant status and grade level

Ethnicity and gender	Participants, by grade level			Nonparticipants,* by grade level		
	7-9	10-12	Total	7-9	10-12	Total
Total	95	104	199	32	38	70
Race/ethnicity						
American Indian . . .	2	0	2	1	1	2
Asian/Pacific Islander	8	20	28	2	8	10
Black (non-Hispanic)	29	10	39	6	5	11
Hispanic	8	9	17	2	3	5
White (non-Hispanic)	48	65	113	21	21	42
Gender						
Male	36	48	84	15	18	33
Female	59	56	115	17	20	37

*Fourteen of the 84 respondents in the "nonparticipant" group reported that they actually were YSP participants. These students are excluded from this table and from other analyses of nonparticipant characteristics.

Estimation Procedure

Even though the YSP impact interviews were unstructured, it is necessary to "force" the findings into quantitative categories whenever there is a need to aggregate or summarize results across the boundaries of the 12 sampling groups. The reason is that some YSP subgroups are represented in the data much more heavily than others. At the high school level, for example, "converts" (students who were not strongly interested in science careers prior to YSP but who subsequently did report such an interest in the latest COSMOS followup) are heavily represented in the data base: we completed interviews with one-third of all students in this group. "Stayers" (students who were strongly interested in science careers before YSP and who continued to report this interest on the latest COSMOS followup) are more common in the program, but are represented much more thinly in our data base: we interviewed only 1 out of every 28 such participants.

To adjust for these marked disparities in representation, "weighted" analyses were conducted whenever findings were aggregated across sampling groups. The estimation weights for these analyses were, in principle, the product of two terms: the respondent's initial selection weight (the inverse of the selection probability that applied to the student's sampling group) and a nonresponse adjustment (the inverse of the response rate for the group). In this study, the estimation weight can be simplified: for each of the 12 sampling groups, it is the total number of students in the YSP program, divided by the final number of respondents. These estimation weights are shown in Tables 2 and 3.

STIS

The Science & Technology Information System (STIS) at the National Science Foundation

What is STIS?

STIS is an electronic dissemination system that provides fast, easy access to National Science Foundation (NSF) publications. There is no cost to you except for possible long-distance phone charges. The service is available 24 hours a day, except for brief weekly maintenance periods.

What Publications are Available?

Publications currently available include:

- The *NSF Bulletin*
- Program announcements and "Dear Colleague" letters
- General publications and reports
- Press releases, Other NSF news items
- NSF organizational and alphabetical phone directories
- NSF vacancy announcements
- Award abstracts (1989-now)

Our goal is for all printed publications to be available electronically.

Access Methods

There are many ways to access STIS. Choose the method that meets your needs and the communication facilities you have available.

Electronic Documents Via E-Mail. If you have access to Internet e-mail, you can send a specially formatted message, and the document you request will be automatically returned to you via e-mail.

Anonymous FTP. Internet users who are familiar with this file transfer method can quickly and easily transfer STIS documents to their local system for browsing and printing.

On-Line STIS. If you have a VT100 emulator and an Internet connection or a modem, you can log on to the on-line system. The on-line system features full-text search and retrieval software to help you locate the documents and award abstracts that are of interest to you. Once you locate a document, you can browse through it on-line or download it using the Kermit protocol or request that it be mailed to you.

Direct E-Mail. You can request that STIS keep you informed, via e-mail, of all new documents on STIS. You can elect to get either a summary or the full text of new documents.

Internet Gopher and WAIS. If your campus has access to these Internet information resources, you can use your local client software to search and download NSF publications. If you have the capability, it is the easiest way to access STIS.

Getting Started with Documents Via E-Mail

Send a message to the Internet address **stisserv@nsf.gov**. The *text* of the message should be as follows (the Subject line is ignored):

get index

You will receive a list of all the documents on STIS and instructions for retrieving them. Please note that all requests for electronic documents should be sent to **stisserv,** as shown above. Requests for printed publications should be sent to **pubs@nsf.gov.**

Getting Started with Anonymous FTP

FTP to *stis.nsf.gov*. Enter *anonymous* for the username, and your E-mail address for the password. Retrieve the file "index". This contains a list of the files available on STIS and additional instructions.

Getting Started with The On-Line System

If you are on the Internet: *telnet stis.nsf.gov*. At the login prompt, enter *public*.

If you are dialing in with a modem: Choose 1200, 2400, or 9600 baud, 7-E-1. Dial (703) 306-0212 or (703) 306-0213

When connected, press *Enter*. At the login prompt, enter *public*.

Getting Started with Direct E-Mail

Send an E-mail message to the Internet address **stisserv@nsf.gov**. Put the following in the text:

get stisdirm

You will receive instructions for this service.

Getting Started with Gopher and WAIS

The NSF Gopher server is on port 70 of **stis.nsf.gov.** The WAIS server is also on **stis.nsf.gov.** You can get the ".src" file from the "Directory of Servers" at **quake.think.com.** For further information contact your local computer support organization.

For Additional Assistance Contact:

E-mail: *stis@nsf.gov* (Internet)

Phone: (703) 306-0214 (voice mail)

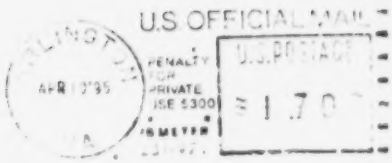
TDD: (703) 306-0090

NSF 94-4
(Replaces NSF 91-10)

NATIONAL SCIENCE FOUNDATION
ARLINGTON, VA 22230

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE $300

RETURN THIS COVER SHEET TO ROOM P35 IF YOU DO NOT WISH TO RECEIVE THIS MATERIAL ☐, OR IF CHANGE OF ADDRESS IS NEEDED ☐, INDICATE CHANGE INCLUDING ZIP CODE ON THE LABEL (DO NOT REMOVE LABEL).



00145173 ERIC
ERIC FACILITY
1301 PICCARD DRIVE
SUITE 300
ROCKVILLE MD 20850-4305

NSF 95-50 (new)